Introduction to Data Collection

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A College Course on
Geospatial Technology

AgrowKnowledge™

The National Resource Center for Agriscience & Technology Education

Table of Contents

One of AgrowKnowledge's strengths lies in its ability to hold Faculty Development Workshops that showcase the use of technology applied to agricultural education. A series of standardized workshops have been created and will be offered annually on a regional basis. This will allow expansion of the number of workshops that are offered each year, make them more accessible and affordable to secondary and postsecondary instructors. These standardized workshops, taught by AgrowKnowledge certified instructors, will provide an avenue toward the sustainability of AgrowKnowledge as a Resource Center.

AgrowKnowledge regional workshops deal with emerging agricultural technology and have previously been held as successful national workshops. An experienced facilitator will lead the workshop using hands-on activities developed by AgrowKnowledge partners. Materials and activities are made available to participants; much of the materials are appropriate for secondary or postsecondary instruction. Workshops can also be adapted for an organization's specific needs.

Geospatial Series

- Introduction to GPS
- Introduction to GIS
- Introduction to Data Collection
- Advanced Data Collection
- Introduction to Spatial Recordkeeping
- Guidance and Control
- Variable Rate Application
- Introduction to Ag Analysis
- Ag Spatial Analysis

Biotechnology Series

- Biotechnology I
- Biotechnology II
- Bio-Link Fellows Institute

Science and Math in Ag Applications

- Fertilizers
- Livestock Production
- Environment
- Plant and Soils

Deere and Co. has provided funding for the development of workshop materials and support of the regional workshops. National Science Foundation has provided funding for the initial structure of curriculum materials and national workshops.

Introduction to Data Collection

Description:

This workshop will provide the instructor with introductory skills in GPS and GIS as applied to agriculture. Participants will learn the use of GPS for simple data collection and GIS for displaying maps of this data. The purpose of this workshop is to give participating instructors the hands-on experience in order to use these fundamental exercises in the classroom to teach these concepts. Introductory information is included in Workshop Introduction.ppt

Learning Objectives

Upon completing this workshop participants will be able to:

- Use a GPS receiver to collect waypoints
- Collect simple feature information and attribute data
- Transfer data and display it in a GIS
- Understand the value of spatial data for a manager

Prerequisite Knowledge

Before attending this workshop participants should be able to:

- Describe what a GPS will do
- Describe what a GIS is
- Use a Windows operating system to efficiently move files and complete dialog boxes and “wizards”
- Use Microsoft Word and Excel
- Demonstrate what latitude and longitude is.

Course Structure

This material is designed to be used in the classroom with high school students (grades 11 or 12) or college students (years 13 or 14). It is recommended that it be included as a module within a high school agriculture or technology course or as a module within Introduction to Precision Farming for college students. It could also be incorporated into horticulture, biology, geology, soils, crops or any other class in which data is collected based on a spatial location.

Listed below is a suggested outline for teaching the material as a classroom module.

Introduction to Data Collection		
Prerequisite knowledge	5 hrs	Lesson - Prereq
Collect Waypoints using Garmin Etrex	2 hrs	Lesson 1
Review and prepare data layers (ArcCatalog)	2 hrs	Lesson 2
Add data layers to GIS (ArcMap)	1 hr	Lesson 3
Edit attribute table	2 hrs	Lesson 4
Add XY data table	1 hr	Lesson 5
Save data and map	1 hr	Lesson 6
Create and print a layout	2 hrs	Lesson 7

This material can also be used within the structure of a workshop for students or instructors. Listed below is a recommended workshop agenda. AgrowKnowledge has certified instructors ready to facilitate this workshop for your group of educators. Contact 866 – 4AG-KNOW for more information.

Regional Workshop Agenda	
Day 1	
10:00 am	Introduction of workshop
	Objectives
	Pretest materials
10:30 am	Prerequisite knowledge of geospatial technologies (Lesson – Prerequisite)
	GPS – How the system works and functions
	GIS – Structure and functions
	Geodosy concepts – coordinates and projections
11:00 am	Location exercise – Use of GPS to determine location
	Navigation exercise – Use of GPS to navigate to a location

12:30 noon	Lunch break
1:15 pm	Collect Waypoints using Garmin Etrex -(Lesson 1)
2:45 pm	Expanding the datalogging exercise – discussion of variations to exercise for use in participant's school
3:30 pm	Review and prepare data layers (Lesson 2)
5:00 pm	Adjourn for the day
Day 2	
8:00 am	ArcView - Basics
	Add data layers to GIS (Lesson 3)
9:00 am	Edit attribute table (Lesson 4)
10:30 am	Add XY data table (Lesson 5)
11:15 am	Save data and map (Lesson 6)
12:00 noon	Lunch break
12:45 pm	Create and print a layout (Lesson 7)
2:15 pm	Review lessons and processes
3:45 pm	Building instructional material – Participants will create a draft version of materials from the workshop that can be used in their classroom.
5:00 pm	Adjourn

Regional Workshops

Geospatial Series

Introduction to Data Collection

Prerequisite Knowledge

AgrowKnowledge Regional Workshop – Geospatial Series

Background

Before anybody can start collecting data, they need to understand some basic geospatial concepts and become familiar with the GPS units they will be using. In completing Lessons 1 – 7 of this module it is expected that the students have some prerequisite knowledge about this technology. This "pre" lesson provides some simple exercises to familiarize the students with GPS and its operation.

The instructions within this lesson are based on using the Garmin eTrex. *Special note: If a different brand or model of GPS unit is being used, the instructions will need to be adapted as necessary.*

Objectives

Students will be able to:

- Describe the segments and operation of the GPS system
- Use a GPS unit to check on current location
- Edit the position format that the coordinates are displayed in
- Use a GPS unit to navigate to a waypoint

Instructor Outline

1. Familiarize students with precision farming and geospatial technologies
    a. What are Geospatial technologies? (Use Introduction to Geospatial Technologies powerpoint)
        i. This power point is a comprehensive presentation on what precision farming is and how its related to GPS and GIS.
        ii. For students completely new to GPS, this PowerPoint can be used for a more detailed discussion before attempting this set of exercises.
    b. Familiarize students with GPS unit– basic terminology and buttons
        i. GPS screenshots - animated
            1. Satellite skyplot
            2. Plot screen
            3. Navigation screen

4. Information screen
5. Menu screen
    a. Format screen
    b. waypoint screen

ii. Location Exercise

1. Additional help is included in GPS Exercises PowerPoint
2. Refer to the instruction sheet that provides step-by-step instructions
3. Students will determine the location of various objects in different coordinate systems
4. The coordinates are to be recorded onto a worksheet that the instructor will check

iii. Navigation exercise

1. Additional help is included in GPS Exercise PowerPoint
2. The instruction sheet has step-by-step instructions
3. Students will set and name waypoints
4. Students will select a waypoint for navigation
5. Students will use the navigation screen to arrive at the waypoint

c. Review GIS – Use Introduction to Geospatial Technologies powerpoint
    i. Components of a GIS
    ii. Functions of a GIS
    iii. ArcCatalog and ArcMap Interface (screens and menu bars use GIS Exercises powerpoint to demonstrate)

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #1 – Collecting Waypoints

Background

Collecting data is a major use of GPS that provides businesses with the information needed to make decisions. Though there are more detailed and advanced ways of collecting data, a basic method is to use a simple handheld GPS unit and record the location and attribute data on a paper worksheet.

This method is beneficial to education because it provides an in-depth look at the various steps involved in geospatial data collection; some of these steps are “transparent” in more advanced data collection systems but are important for students to understand. It is also a more cost effective way for educators to integrate the technology in the classroom, costing approximately $100 for a handheld GPS unit.

This first lesson requires mostly work outdoors, covering the actual process of collecting locations and attributes. The data collected in this lesson will be used in subsequent lessons to build a map of the objects the students located.

Objectives

Students will be able to:

- Decide on the type of objects to be mapped with GPS and two attributes to be recorded for each type of object.
- Record the coordinate position for a minimum of four objects
- Record two attributes for each object

Instructor Outline

2. Determine project area and groups of objects to be mapped
    a. Instructor should review the Suggested project and objects
    b. The area should be close and easy to access (i.e. school grounds, field, etc.)
    c. The objects should be easy to find and identify
    d. Pairs of students work well for this exercise; groups of three students should be the maximum.
    e. Each pair of students will decide on one type of object (example: trees) More examples are included in *Suggested projects and objects*
    f. The group will decide on two attributes for which data will be collected (examples: tree height and species) More examples are included in *Suggested projects and objects*

3. Datalogging Exercise
    a. When each pair has determined two attributes to record for each of their objects (example for tree – height of tree and species of tree), they are ready to proceed.
    b. Handout a GPS unit to each pair
    c. Handout a datalogging worksheet to each pair
        i. Have students write their names down on the sheet
        ii. In the headings row, write the two attributes (example : height and species)
    d. For detailed instructions on using the Garmin eTrex see the Flash Simulation.
    e. Acquire a current position with GPS units
    f. Change the position format to decimal degrees (hddd.ddddd on the receiver. See GPS simulation)
    g. Each person will find one of the objects, stand next to it with the GPS receiver and write down the coordinates calculated by GPS onto the worksheet (latitude into the latitude column; longitude into the longitude column)
    h. Next to the GPS coordinates for that object, students will determine and record a value for each of the two attributes. (Example – estimate the height of that tree and write it down in the height column. Then identify the species of tree and write it in the species column)
    i. Each student must record coordinates and attribute values for 4 – 8 objects (as indicated by instructor)

j. Turn in the GPS receiver and worksheet to instructor.

Summary:

In this lesson, students did the basic data collection; recording the location of objects of interest and some useful information about those objects. In advanced agricultural systems such as the Deere AMS Greenstar system, data collection is simplified; locations are automatically recorded and attributes of those locations are automatically recorded or based on entries by the user. It is important to note to the students that this lesson is a demonstration of a process that is a part of all geospatial data collection, i.e. recording a latitude/longitude coordinate for objects in the field.

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #2 – Creating a New Table

Background

The students will have just used a GPS receiver to determine the location of 4 – 8 mappable objects and recorded the location coordinates onto a worksheet. In addition, they determined values for some attributes of each object and recorded that information onto the same worksheet. This worksheet represents raw data, which on the worksheet, is hard to visualize or interpret.

In order to see the points and attributes in spatial terms, i.e. on a map, the locations must be put into a format that a GIS such as ArcView can use. The most basic way of doing this is to create a table that has coordinates and attributes. This is a fundamental concept of any GIS; that a database table is the basis for mapped features. Data coming from a yield monitor, an expensive GPS datalogger, or copied from an Internet source is based on a table of data.

To create the data table, an empty table must first be created. This is done in ArcCatalog (the file management part of ArcView). After the table is created, subsequent lessons will enter the data and import it into ArcMap.

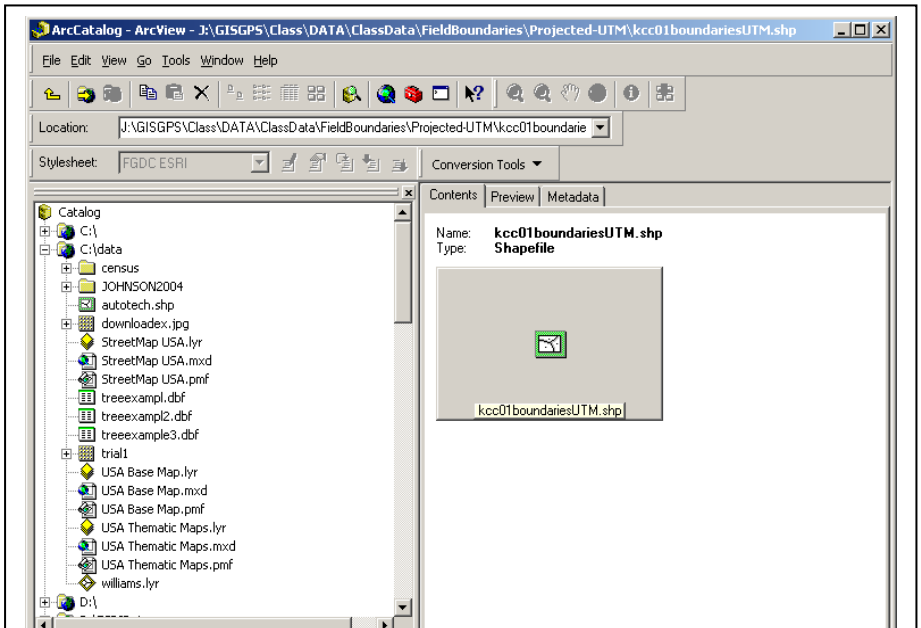
Objectives

Students will be able to:

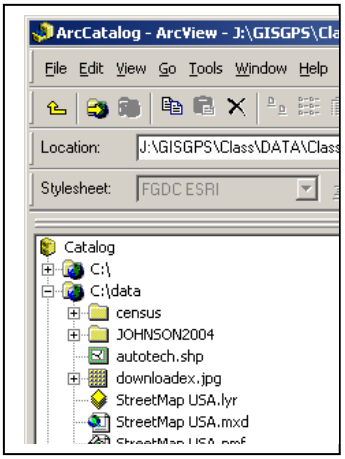
- Open and use ArcCatalog
- Create a new table for entering data

Instructor Outline

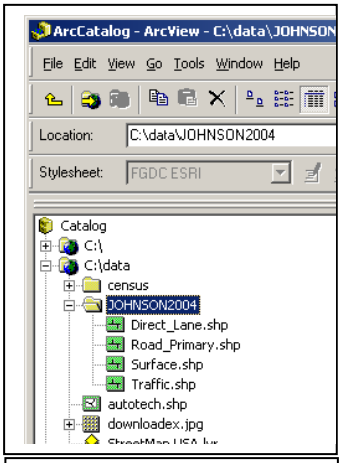
1. Open ArcCatalog
    a. Click on Start / Programs / ArcGIS / ArcCatalog



2. Identify or create a folder to store the new table
    a. If a drive or folder has a + next to it, this indicates that there are subfolders within (collapsed). Click on the + to show the folders (expand). *Note folder “Johnson2004” in left graphic below is collapsed*



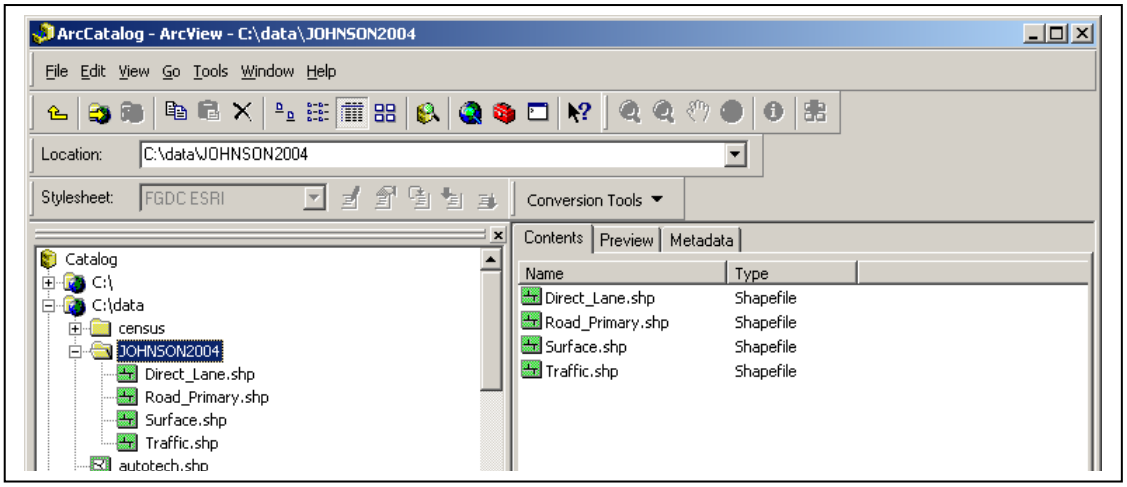
Collapsed View



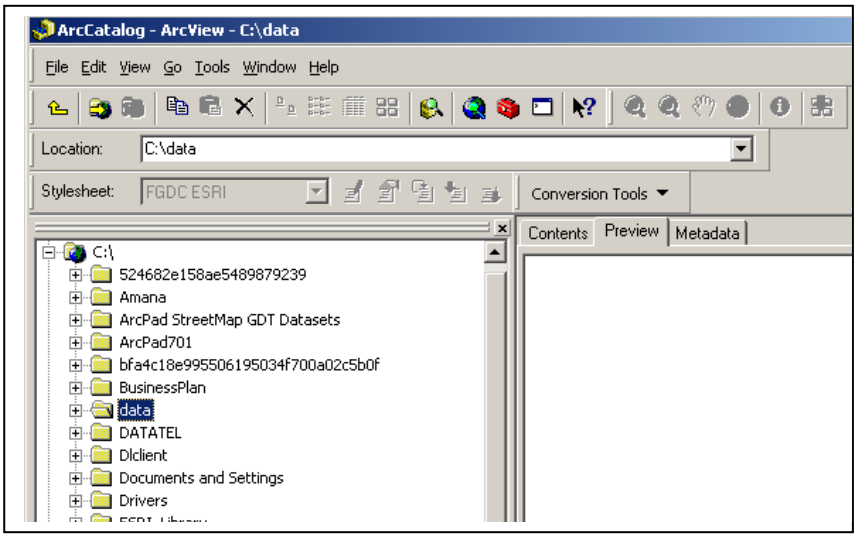
Expanded View

    b. If a drive or folder has a - next to it, it is showing all of the subfolders within (expanded). Click on the - to collapse and hide the subfolders. *Note folder “Johnson2004” in right graphic above is expanded*

c. Highlighting a folder in the left section (the “directory tree”) will display the contents of that folder in the right section. *Note folder “Johnson2004” is highlighted; files within “Johnson2004” are shown in the right section*



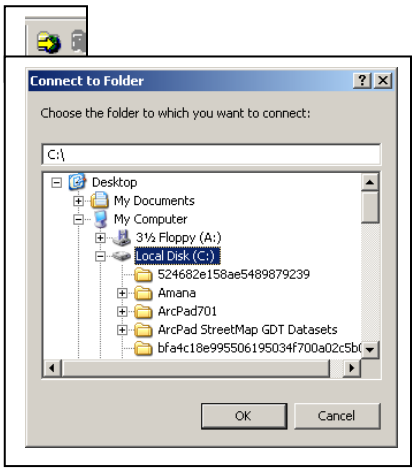
d. Using the + or the - find the folder called “data” in the C: drive that you will store the new table in. Click once on it to highlight it. If there is no “data” folder, proceed to the next step.



e. If folder does not yet exist, right mouse click on the C: drive (or other drive where you want the folder to be created), select “new” and then “folder”. This will create a new folder. With the name “new folder” highlighted, type in a new name; “data”

f. If the C: drive or other drive is not listed, the “connect to” button must be used
   i. Click on “connect to”

   ii. Click on the drive that you want to be listed in ArcCatalog *Note that “Local Disk (C)” is highlighted*



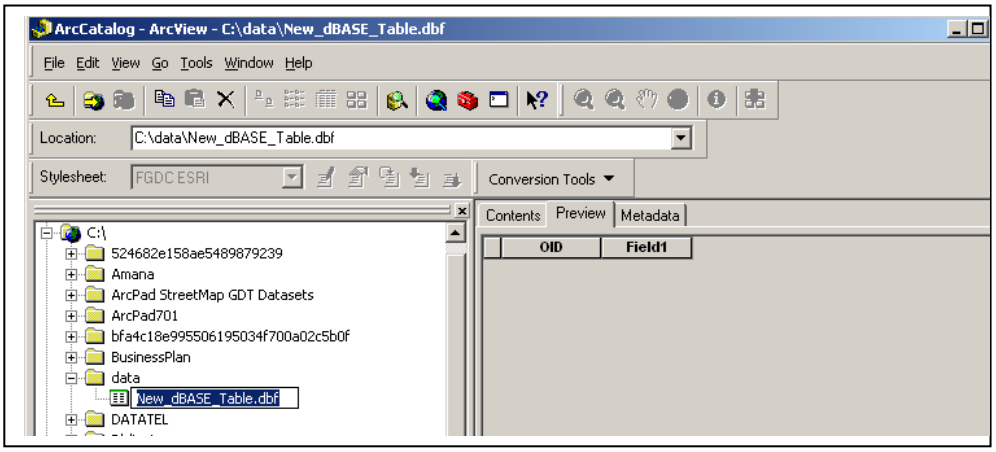
   iii. Click on OK

g. Drive C should now be listed in ArcCatalog and you can create a folder called data. Use step “e.” from above to complete folder creation.

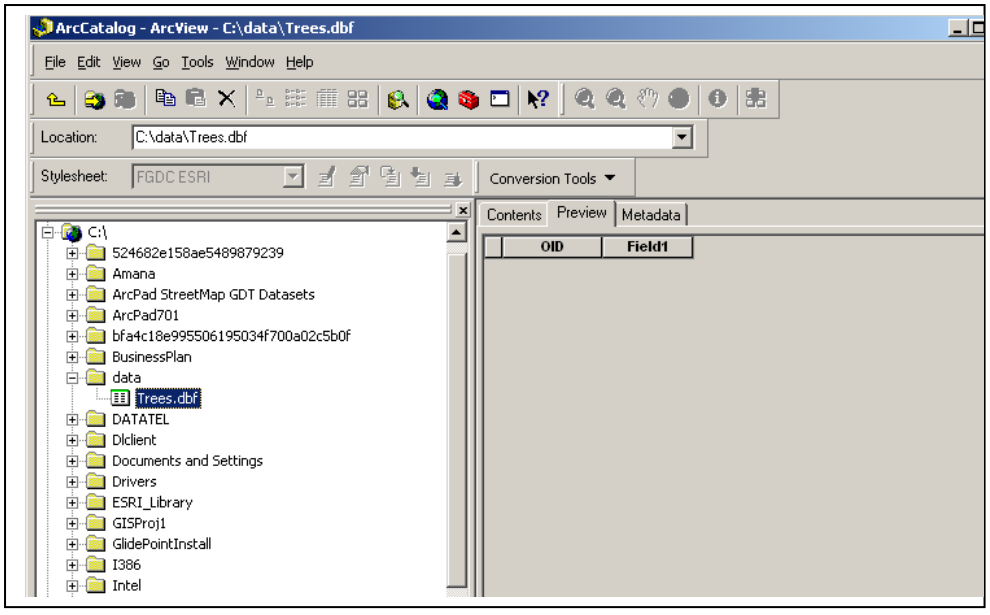
3. Create the new table
    a. Right mouse click on the folder in which the new table is to be stored in

    b. Select New, then dbase table

    c. A new table with a file extension of .dbf will be created.
    note the new file with a name of “New_dBASE_Table.dbf”



    d. Type an appropriate name into the space provided. Since this example will map trees, the name “trees” is used.



e. You now have an empty table stored in the C:drive and data folder. *Note that the table for “trees.dbf” is shown in the right section and has only two columns (or Fields) OID and Field1*

Summary:

This completes the Lesson 2. With this step the students have created a file in which data collected from the field will be stored. This is an important concept since all data collection software and processes result in data files. In the case of agricultural software such as the Deere AMS software, this step is “invisible” to the user i.e. the software automatically creates the file and folders for storage.

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #3 – Add Data to ArcMap

Background

Students have collected data about objects in the field and have created a new and empty table to store this data. This new table was created using ArcCatalog.

ArcCatalog has additional uses in finding, reviewing and defining map data layers. Additional map data layers are important if students are to see how accurate their points are and to see their features in relation to other features. Most agricultural software programs allow the use of aerial photos.

This lesson provides additional experience in the use of ArcCatalog by viewing and manipulating individual map layers from the local area before combining them all together in ArcMap.

This lesson will have a lesser amount of detail when compared to other lessons. Though the use of ArcCatalog is consistent, the finding and downloading of additional map layers is not. Each state will have different methods of retrieving aerial photos or roads for a local area. The steps covered within this lesson are general; however additional helps that may be available are provided.

Objectives

Students will be able to:

- Find and download aerial photos from internet
- Check spatial reference with ArcCatalog
- Edit the spatial reference in ArcCatalog to assure good data for student use.
- Add a data layer (road network or aerial photo) to create an ArcMap project.

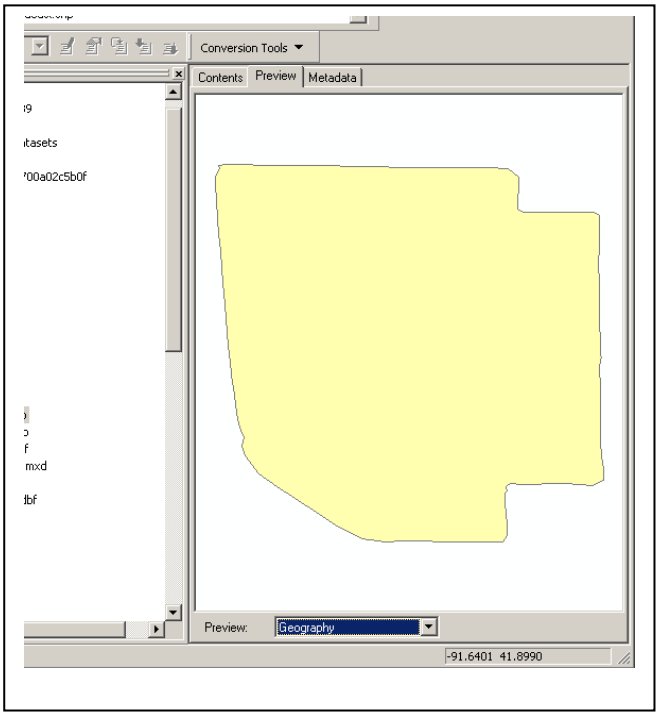
Instructor Outline

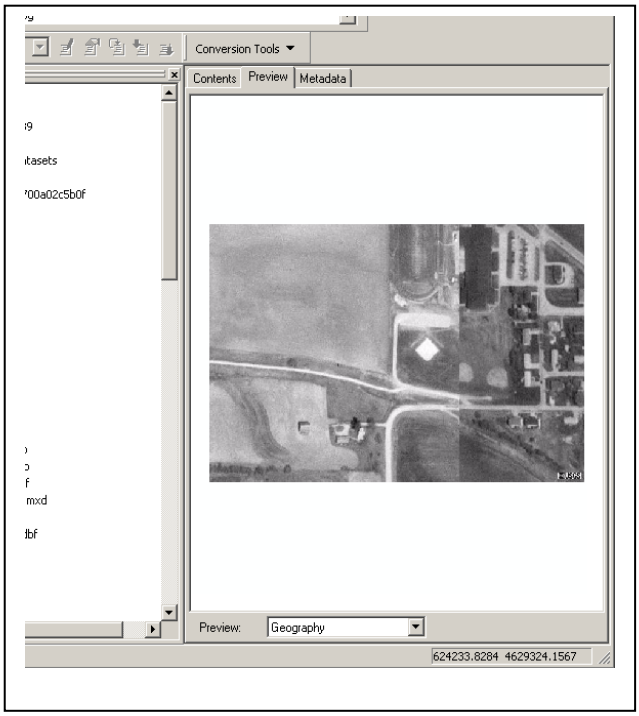
1. Finding a map and data layers from the Internet
    a. Instructions to use an aerial image from Terra-Server
        i. Images may be out-dated but this is a consistent resource for the entire US
        ii. Instructions provide detailed instructions for students
    b. Finding data for your state
        i. Each state should have a geographic information council which may have a clearinghouse of GIS data that is free for download (for example: Iowa is: www.iowagis.org)
    c. Downloading and using data from internet

i. From a clearinghouse, each state will be different, however once you have found a site, step by step instructions are typically included. The document link above provides some additional hints

d. Saving downloaded file
   i. When saving data for use in this project, save to C:/data

2. Check spatial reference of downloaded data with ArcCatalog
   a. Open ArcCatalog
   b. Locate the data layer to be added to ArcMap *Note: use location and browse button to find downloaded file in drive and folder from step 1*
   c. Highlight the name of the data layer
   d. Click on the Preview tab, move the cursor around the map. Make note of the type of coordinates displayed in the lower right-hand corner of the map





e. The coordinates will most likely be either:
    i. GCS (also known as Latitude/Longitude) will look something like: 42.8273049 -91.093874 (see the above graphic, map on the left)
    ii. UTM will look something like: 6434596.47 4742678.87 (see the above graphic, map on the right)

GCS = Geographic Coordinate System, developed over the last 2000 years to place an imaginary grid of vertical (longitude) and horizontal (latitude) lines on the globe to reference location on the earth. The coordinates are in numerical degrees, which actually refer to the angle of your position from the center of the earth to: the equator for latitude or the prime meridian for longitude.

UTM = Universal Transverse Mercator, a coordinate system which divides the globe into 60 vertical zones and 20 horizontal sections to create a grid to reference location on the earth.

f. Right mouse click on the name of the data layer and select properties.
g. Within properties, select
    i. For ArcView9.2; the XY Coordinate tab
    ii. For ArcView9.1; the General table/highlight the line for Fields
h. Observe the coordinate system listed and compare to the spatial reference you wrote down when downloading the map layer or when you looked at the map layer in step e.
    i. If it matches the coordinate system you noted on the map – good
    ii. If it does not match the coordinate system you noted on the map – you will have to change the spatial reference per instructions below
    iii. If it says “unknown” – you will have to edit and add the spatial reference per the instruction below
    iv. If it says that the spatial reference is “assumed” – you will have to edit the spatial reference per the instructions below

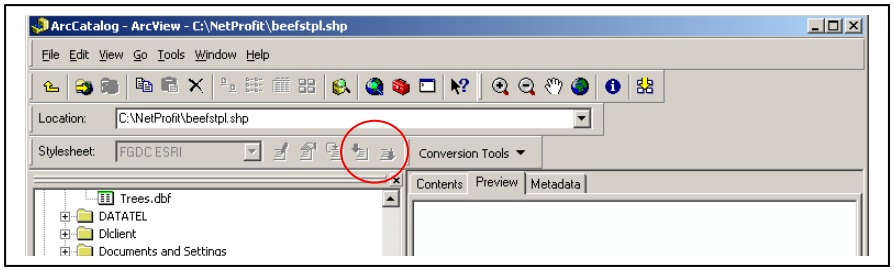
3. Edit the spatial reference. Select the edit button
    a. If it is a UTM
        i. Select folder for “projected”
        ii. Select folder for UTM
        iii. Select appropriate folder for datum (based on metadata)
        iv. Select appropriate zone # (example 15 for Iowa, 18 for NJ, this should have been listed on the website when map layer was downloaded)
    b. If it is in Latitude /longitude
        i. Select folder for “Geographic”
        ii. Select folder for World
        iii. Select file for WGS 84
    c. Click on the Apply and OK buttons to return to properties

Besides UTM and GCS, which are the coordinate system that are commonly used by map layers, you may see “NAD 83” “NAD27” or “WGS84”. These are referred to as DATUMS and provide a “starting point” for coordinate systems. Datums try to account for the shape of the earth which affects how accurate a coordinate system is in its locations.

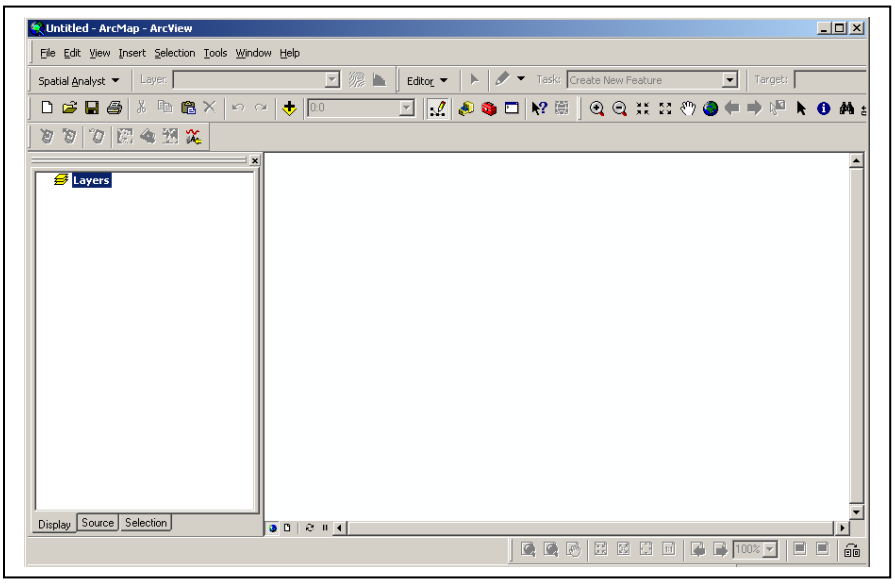
Identifying correctly the datum that is being used by a specific map layer is very important when using more than one map layer together.

4. Add data layer to ArcMap project

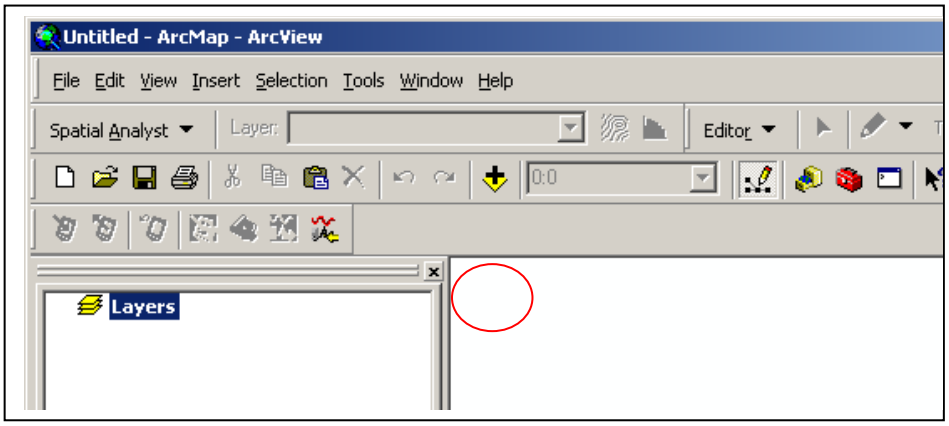
    a. Open ArcMap



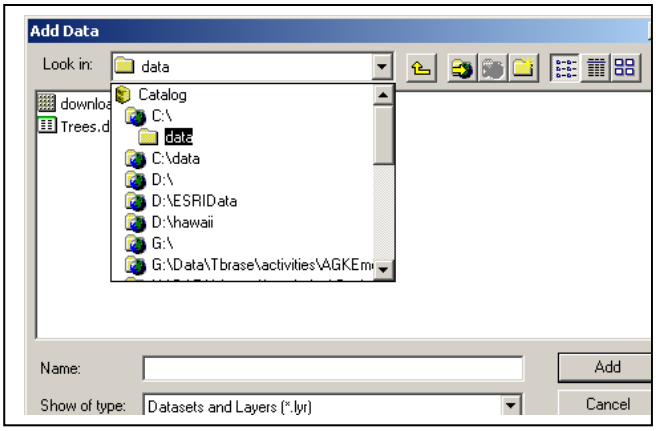
b. ArcMap opens



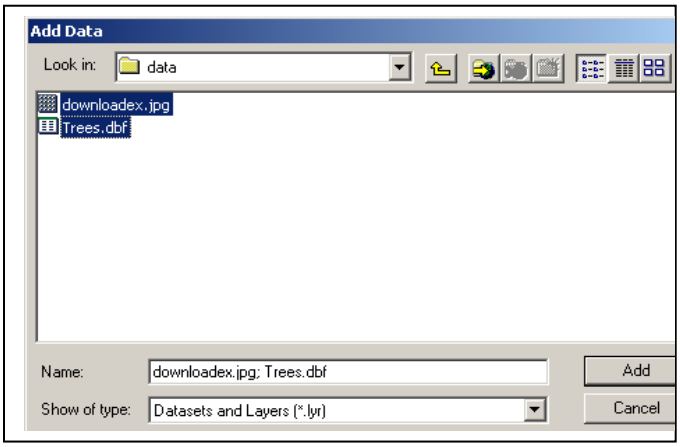
c. Click on “Add Data” button



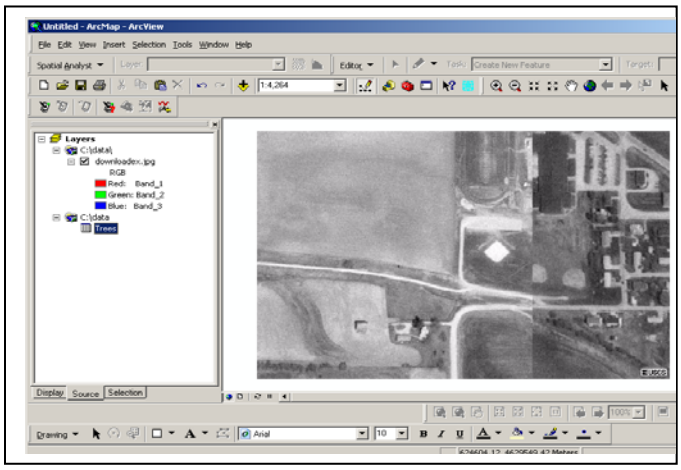
d. Select folder that contains data layer to be added. *Note that in the Add Data box the “Data” folder in the C: drive has been selected*



e. * Note that the “Trees.dbf” file (created in Lesson 2) and downloadex.jpg (downloaded in step 1 of this lesson) are listed.* Highlight both data layers and click on “Add”



Note the result is two data layers in ArcMap



f. Save this as a map. This allows you to open this map in ArcView and have these two layers already added and in the form as when you finish this lesson. To save:
   i. Click on File
   ii. Click on Save as
   iii. Use browse button to select drive and folder
   iv. Enter a filename for the map – “datalogging”
   v. Press enter to complete save
   vi. Note that the title bar of ArcView now shows “datalogging”

Summary

This lesson has created a map from the two data layers that were added to ArcView; the aerial photo and the empty table. Even though the table has no data in it yet, it is listed as a layer. Our next step is to add the data in lesson 4.

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #4 – Edit Table

Background

Students have collected data, both in the field and from the Internet. At this point they have just added the aerial photo or base road map to ArcMap. The next steps are to add the field data to ArcMap so the student's data points can be visualized with the aerial photo layer already in ArcMap.

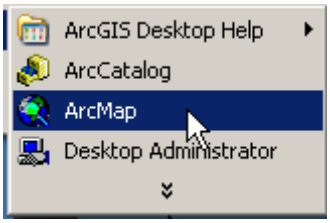
To do this, the data that the students collected in the field must be entered into the empty table created in Lesson #2. ArcMap will be used to do this. This step provides the students with an introduction to editing, a major function in a GIS. The steps used here are similar to steps a technician would use to enter information to build a spatial database.

Objectives

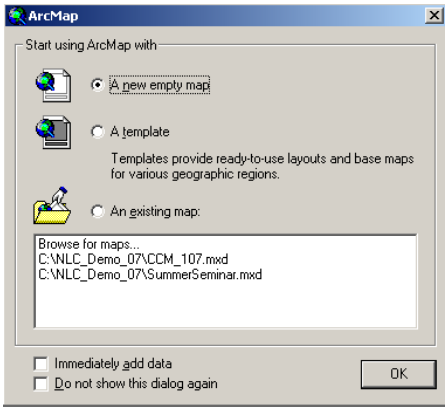
Students will be able to:

- Add new fields for attributes to a blank table
- Initiate the process of editing in ArcMap
- Enter attribute data into the new fields
- Save edits to the table.

Instructor Outline

1. After completing Lessons 1 through 3, open ArcMap 

2. Start using ArcMap with an "Existing Map"

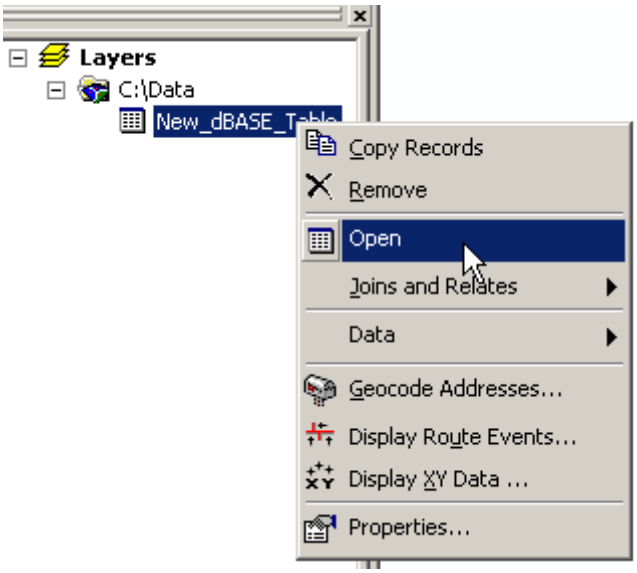


3. Navigate to the folder on C: drive in which the map from lesson 3 was saved. Select the map file ‘datalogging” to use in ArcView.

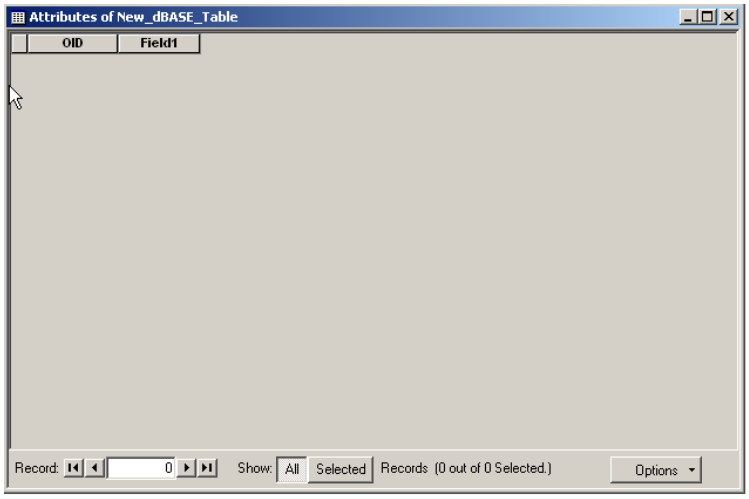
4. Review the table
   a. Right mouse click on name of new table (in the table of contents)

   b. From the resulting menu, select “Open”

   c. Table will open



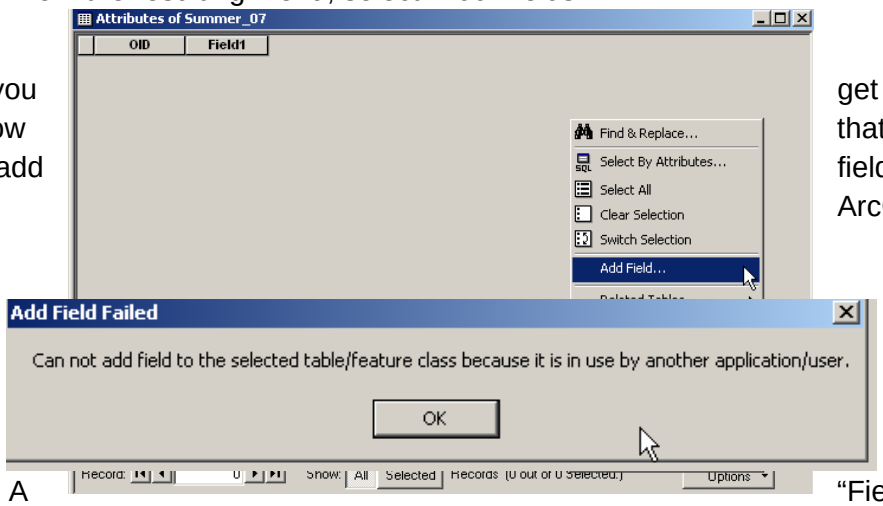
d. Ask students - How many columns are in the table? What are the columns? How many rows are in the table?



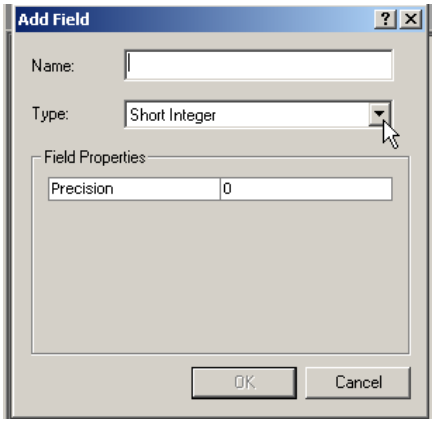
5. Add new fields (columns) for locational and attribute data (note – the new columns that you will be adding are based on what your collected in Lesson #1. Make sure that you have the worksheet from Lesson #1.

   a. Click on the “options” button in the lower right corner of the table
   b. From the resulting menu, select “Add Fields”

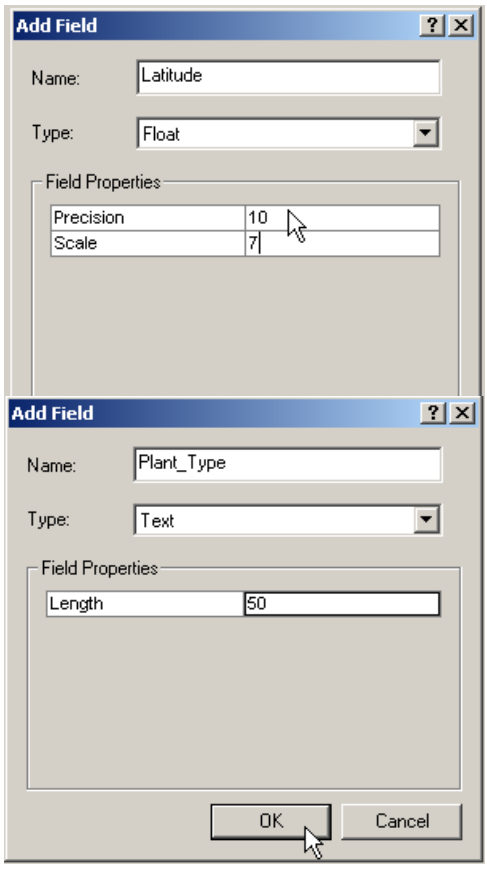
**Note that if you get a message as shown below that will not permit you to add fields you will need to close ArcCatalog.



   c. A “Field Definition” window opens



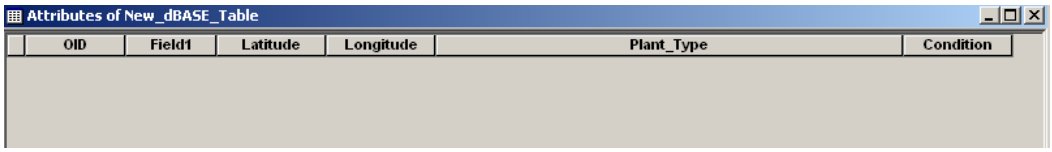
d. Enter “Latitude” as the name (This will be the heading of the column)
e. Enter “Float” as type from the drop down menu.
f. In the windows below Field Properties enter 10 as Precision and 7 as Scale. This allows you to enter a number (representing data collected in the field) into the field (column). Float identifies a number that has decimals; precision of 10 provides a total of 10 digits in the number; scale of 7 provides for 7 digits to the right of the decimal point and 3 digits to the left of the decimal point.
g. Select OK to create the column
h. Repeat adding fields for longitude other attributes



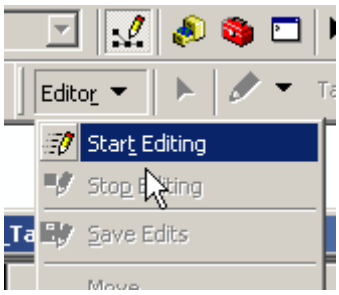
for and and

If one of your attributes is text, the screen below will be used. Enter the name of the field in NAME, and select Text as the TYPE as shown below. For length you will need to enter the number of spaces needed based on the length of data you will be entering (50 shown). When entering the Name of the field, be sure not to leave spaces – instead use an “underscore” between words in the field name

6. The table shown below has column (field) headings for Latitude, Longitude, Plant Type, and Condition.

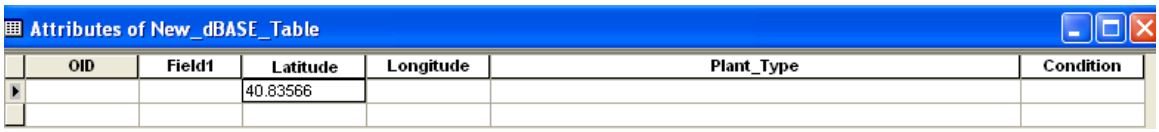


7. Add field data to table
   a. From editor toolbar start editing - If there is no “Editor Toolbar” shown in ArcMap; select “View” from the “Menu” bar; select “Toolbars”; and then check “Editor” in the list of toolbars (This will turn headings white and add a row)

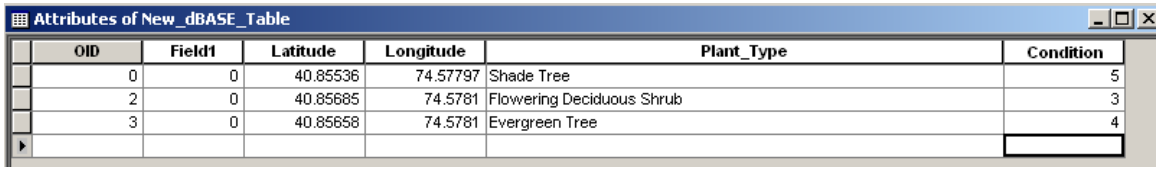


Note the change to white as a background color

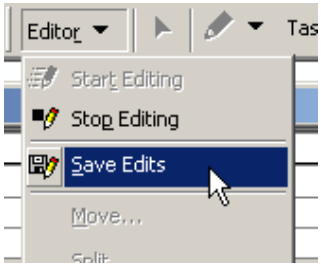
   b. In the row that is created, click under the latitude column and enter the first latitude. Continue with remaining attribute data.



   c. Repeat for each row until all objects are entered



   d. Click on “Editor” and select “Stop Editing”. Make sure to select “YES” when it asks you if you want to save your edits. Use the name of the objects mapped as the filename. In this example the filename will be “trees”



NOTE – after clicking on Stop Editing, some of your rows of data may disappear. This is temporary; if you close the table window and then open it up again (right mouse click on table name and select “Open”) all of your rows will be back.

Summary

The end result of this lesson is a new complete table. The new empty table created in Lesson #2 has been filled in with data collected with the GPS unit in Lesson#1.

Though this is a slower process, precision farming software packages work very similar. The GPS unit calculates and captures locational data (i.e. the latitude and longitude). Attribute data, collected by a sensor or the operator, is fed into a computer, which is then combined with the locational data. This is similar to what you did on the worksheet and then entered into the table. In both cases we end up with georeferenced data (data that has a spatial component).

The next step is to bring this layer into ArcMap so that it can be seen along with the aerial photo.

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #5 – Add XY Data

Background

The students' projects include a base aerial photo or road layer and a table of field data. At this point the table is listed in the table of contents (the section on the left in ArcMap where all the data layers are listed) but nothing shows up on the map.

This is because the table does NOT have spatiality; that means that ArcMap does not recognize the numbers in the table as coordinates, therefore it is not georeferenced (aligning data with a coordinate system in order to be displayed with other data layers). However it can be georeferenced because the table does have a series of latitude and longitude points. These coordinates can be plotted just like points on a x,y graph. This is why the next step is call "Add x, y Data"

Students will identify their table as data to be georeferenced by selecting which columns represent x and which column represents y, and finally set the spatial reference (coordinate system).

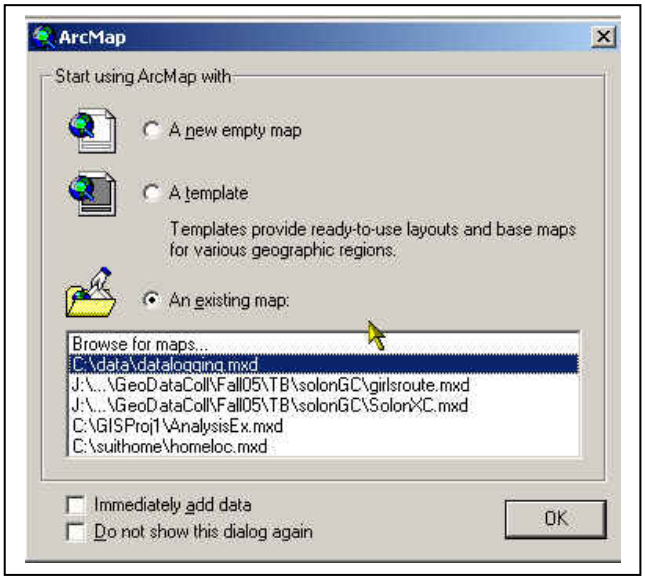
Objectives

Students will be able to:

- Open the “Add XY Data” dialog window
- Identify correct X and Y coordinates
- Assign the correct coordinate system

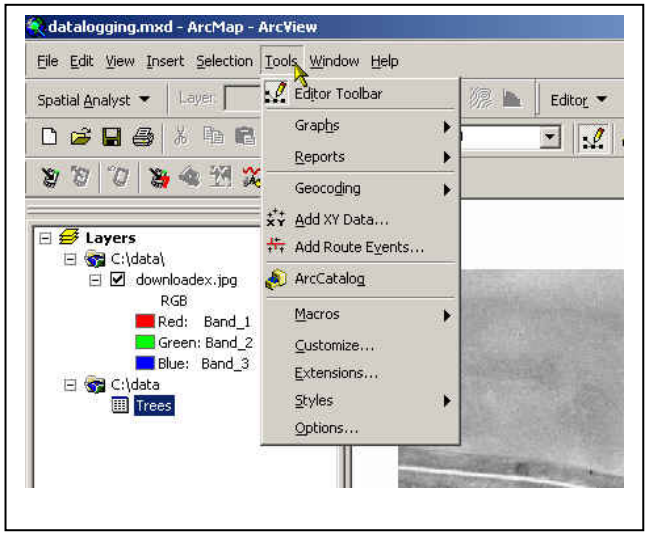
Instructor Outline

1. Open ArcMap, selecting “An Existing Map” and choosing “Datalogging”



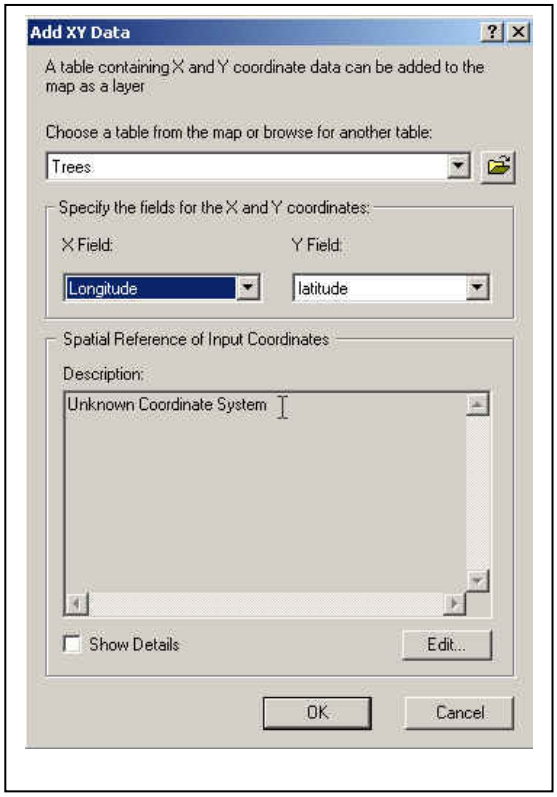
Open “Add X,Y Data”

a. From the menu bar select “tool”
b. Select “Add X, Y Data”
c. This opens the Add XY Data dialog window

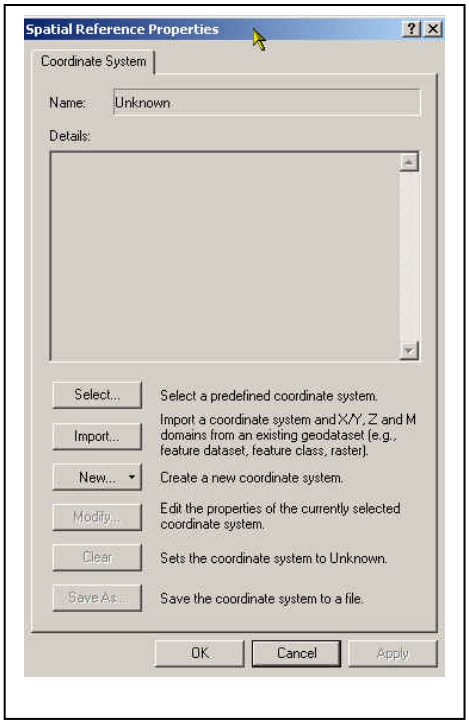


Complete the dialog window

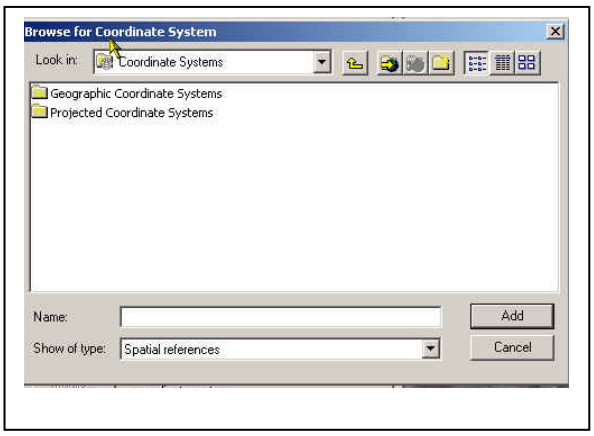
d. Select the table just saved (“trees” in this example)
e. Select “longitude” for X
f. Select “latitude” for Y
g. Discuss with the students why longitude is =X and latitude = Y (relate to graph axis)



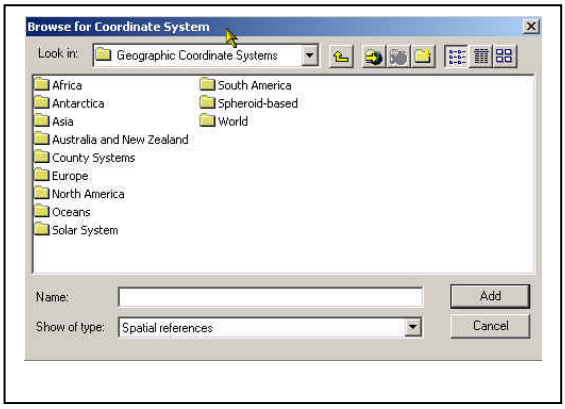
2. Select the coordinate system
    a. Discuss the importance of identifying the CORRECT coordinate system
    b. *Show map completed using incorrect coordinate system and map completed using correct system.*
    c. Discuss what the coordinate system is (if collected with GPS, it most likely is GCS Geographic Coordinate System – WGS 84)
    d. Click on “Edit” at the bottom of the Add XY Data dialog window



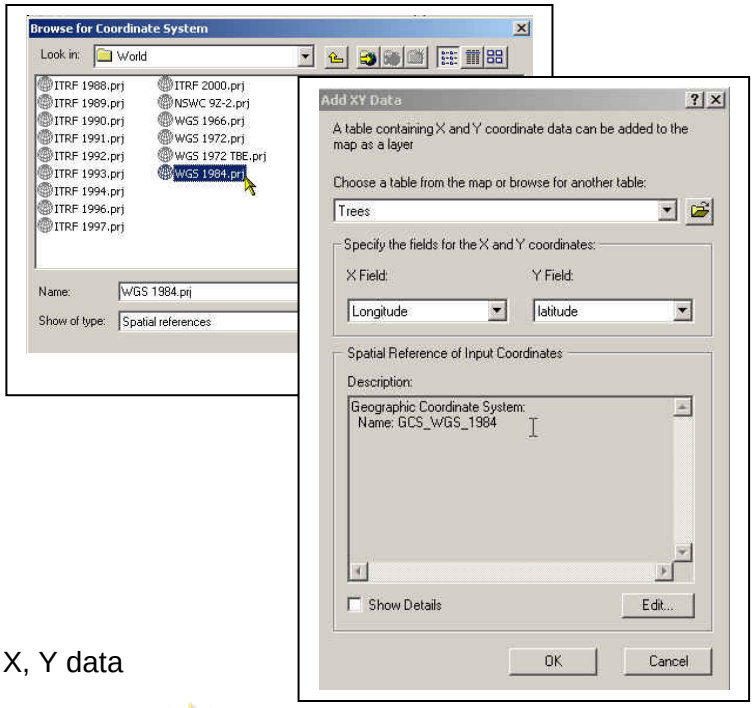
e. This gives you a Spatial Reference dialog window. Click on “Select”



f. This gives you the Coordinate Systems dialog window. Assuming that the data was collected in Lat/Long coordinates, click and open the folder called “Geographic”



g. Open the folder called “World”
h. Highlight the file called “WGS84”
i. Click on “Add,” then “OK” to get back to the Add XY Data dialog window



3. Click on “OK” to finish and add the X, Y data

4. A new data layer will appear in the Table of Contents and points will appear on the map

5. This is a temporary layer and is not a permanent part of the project. Lesson #6 describes the process of making this a permanent map layer. It is suggested that you do Lesson #6 right away and DO NOT CLOSE ArcMap. Closing ArcMap and you risk losing the tree event layer you just created. If this happens, these steps can be easily repeated to create it again!

Summary

You have just taken the raw data that was entered into a table and entered it into ArcMap so that it is displayed with the aerial photo. This can be impressive as students can match up the trees they mapped with the object in a photo.

This is a simple type of georeferencing; associating data with a spatial coordinate. However it is NOT in a format that ArcMap can use permanently; think of this as a test layer to look at before converting it to a data layer in Lesson #6

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #6 – Export Event Theme

Background

After the previous step students could finally see their data and an aerial photo or road layer together. Many students will respond with amazement as they pointed out the various objects that they mapped and how close (or far away) it is to the same object on the photo. This may generate some questions about accuracy.

However, before any other step is taken, this X, Y table must be saved as a data layer. Currently, ArcMap sees these mapped points as a temporary georeferenced table. Note: If the students were to close ArcMap at this point and open it back up, their X, Y table would NOT be present. If students want to save this it must be exported. By exporting, ArcMap puts this into a standard format (commonly called a “shapefile”) that can be used in the future.

Objectives

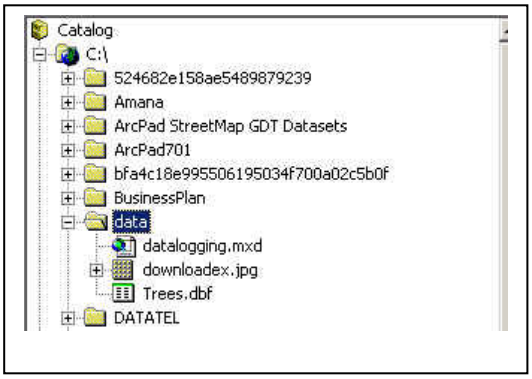
Students will be able to:

- Describe the need for exporting the X,Y data layer
- Use the “Export Data” function

Instructor Outline

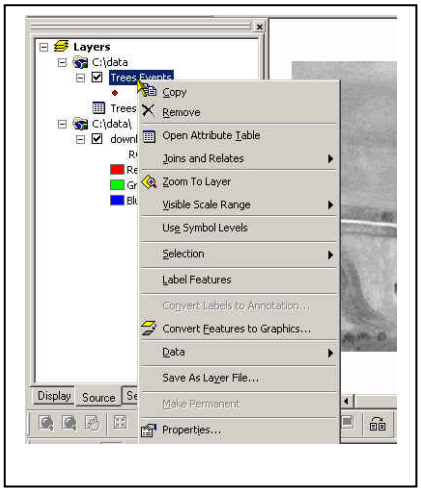
1. Discuss need to export X, Y data layer
    a. Review the process to create X, Y data layer
    b. Make note of the way the layer is listed in the table of contents (as “trees events”

c. In ArcCatalog look at the project folder and note that there is not a file for the X, Y data (other than the original table)

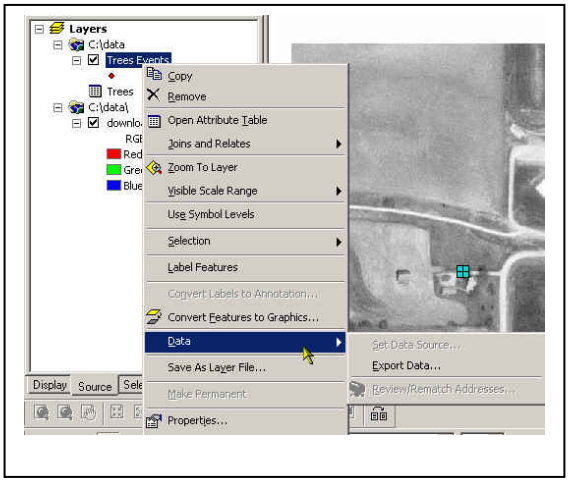


d. Discuss (or demonstrate) what would happen if project was saved and opened again. (no X, Y data layer.. only the table)

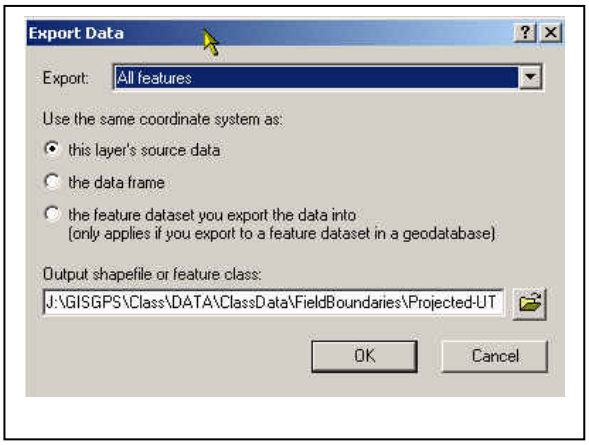
2. Export data
   a. Right mouse click on the X, Y data layer in ArcMap



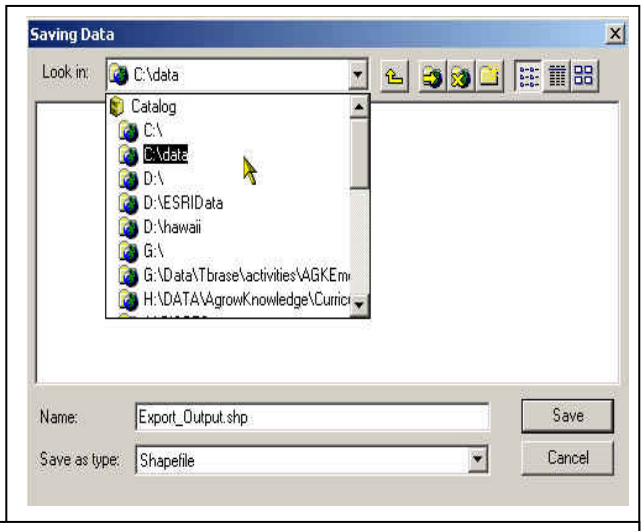
b. From the right mouse menu (shown above), point to “data”. This opens another menu



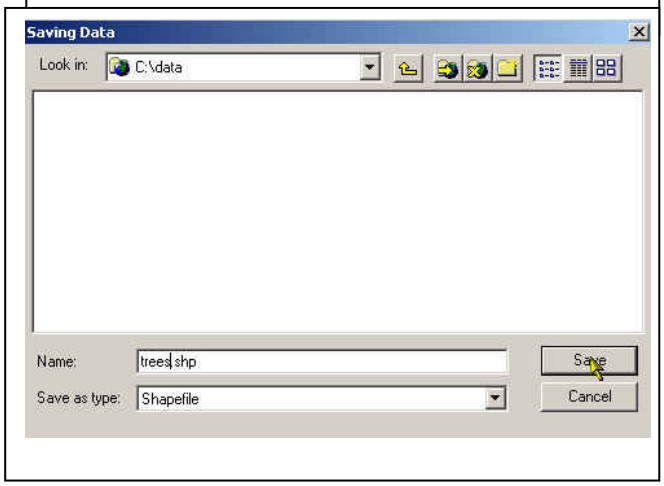
c. From this menu, select “export data”. This opens a dialog box



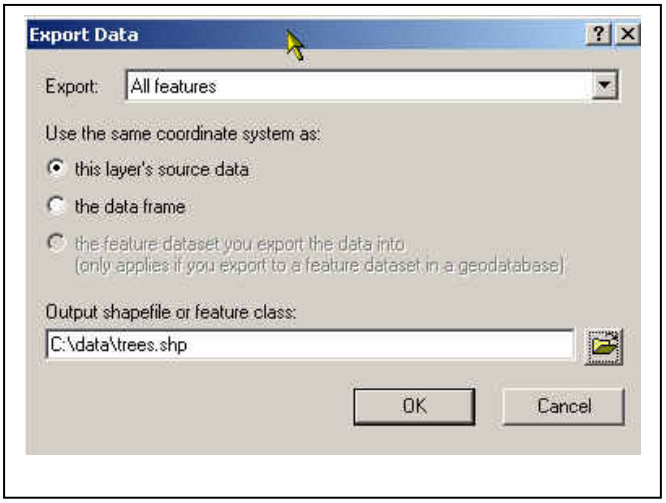
d. Accept the default of “all points/features”
e. Click on the folder icon. This opens the “Saving Data” dialog window. Browse to the project folder
f. Enter a filename that identifies the features being saved and is different than the name of the table file you created earlier.(in this example we are mapping and saving a data layer of trees)



g. Click on “Save” to accept the exporting data

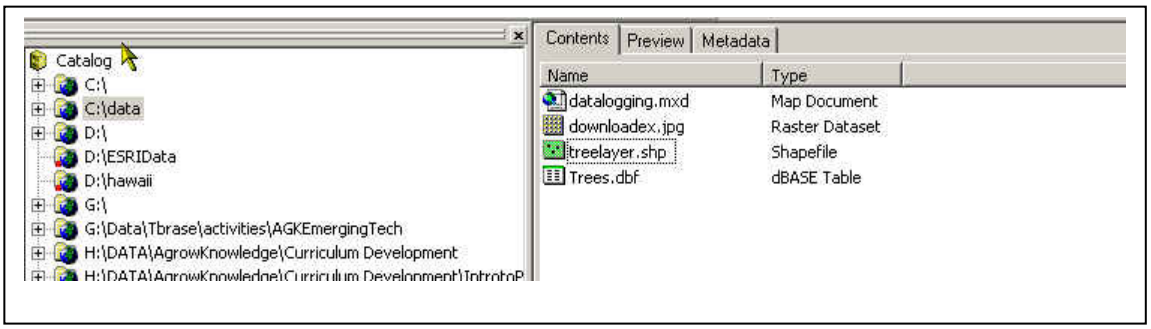


h. This returns you to the Export Data window. Click “OK”



3. Explore what this did
   a. Added another layer to the table of contents
   b. The new layer is listed as a shapefile

c. The new exported layer is listed in ArcCatalog



Summary:

This lesson introduces the concept of file formats that different GIS have. ArcView uses a format called “shapefile”. Most systems such as Deere’s AMS use their own format.

Without this step, the mapped points that the students created were in a raw format. It can be noted to the students that these raw formats are important to GIS because they can be used by multiple GIS. Often, when converting data from one GIS to another, a raw format such as this is used. For example, to use data from the Deere AMS in ArcView it is converted first to a raw text format.

This lesson finalizes the data collection and processing. The last lesson creates map layout to visualize their work.

Regional Workshops

Geospatial Series

Introduction to Data Collection

Lesson #7 – Creating a Layout

Background

Students will have a small but valid project, with data acquired from the internet and data collected from the field. Though simple, it does demonstrate basic concepts in data collection.

The last step is to build a map layout to present and visualize the project. This is a more difficult lesson to provide step by step instructions for since there are many variations in how a layout can be created. Listed below are general steps with some examples of layouts.

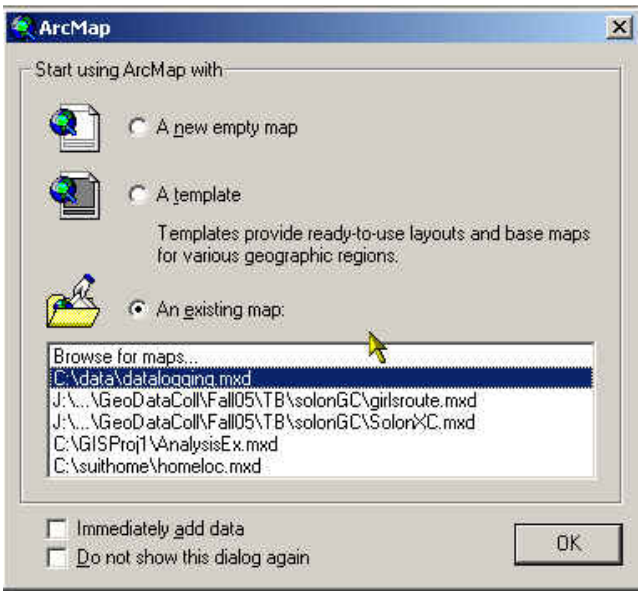
Objectives

Students will be able to:

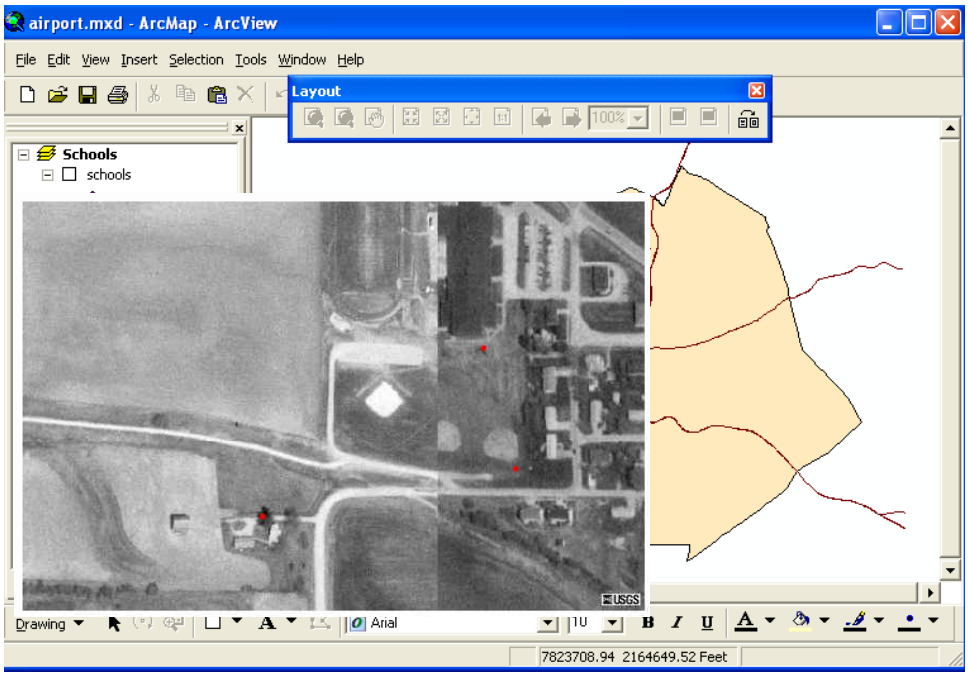
- Open a layout view and insert map components into the layout
- Arrange and edit the components
- Print out a hard copy of the map

Instructor Outline

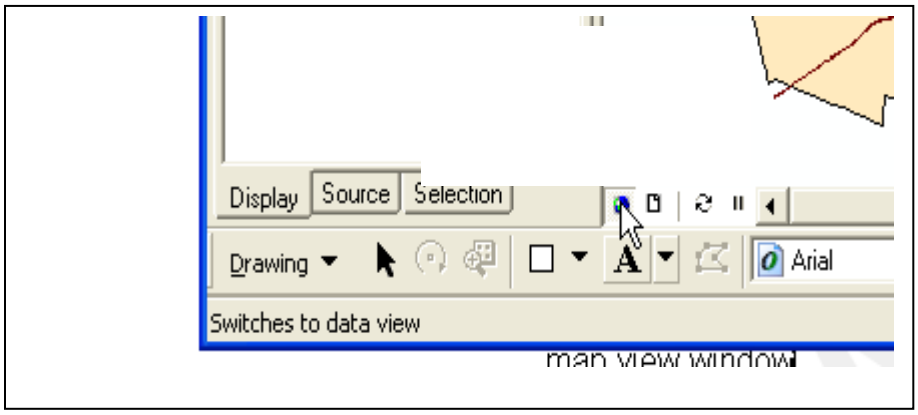
1. Open ArcMap, and select “open an existing map” from the dialog window. Select the map created in previous lessons.



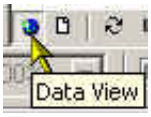
2. Open layout view



a. Use the mouse to point to the buttons in the lower left corner of map view window

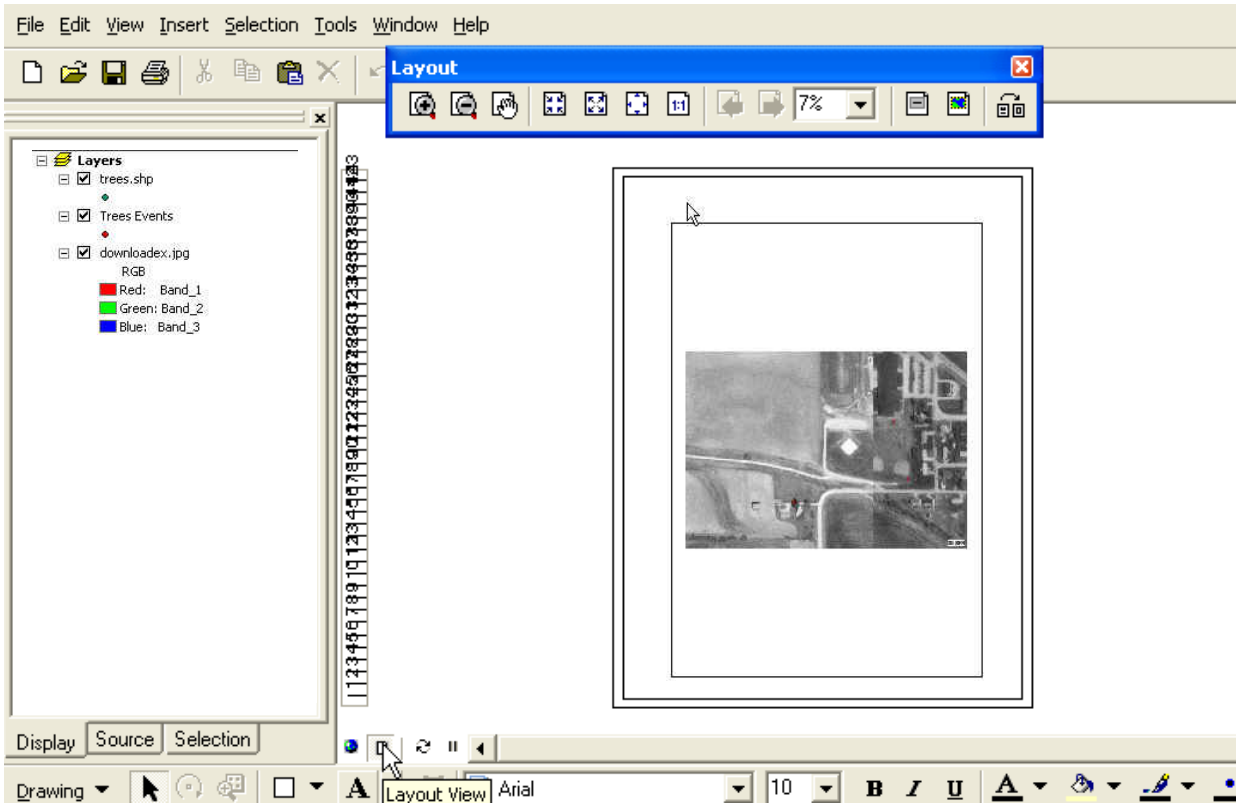


b. *note: the explanation which appears in the very lower left corner of the ArcMap screen which tells you what each button will do – in the image shown with the cursor pointing at the “globe” the explanation is “data view”

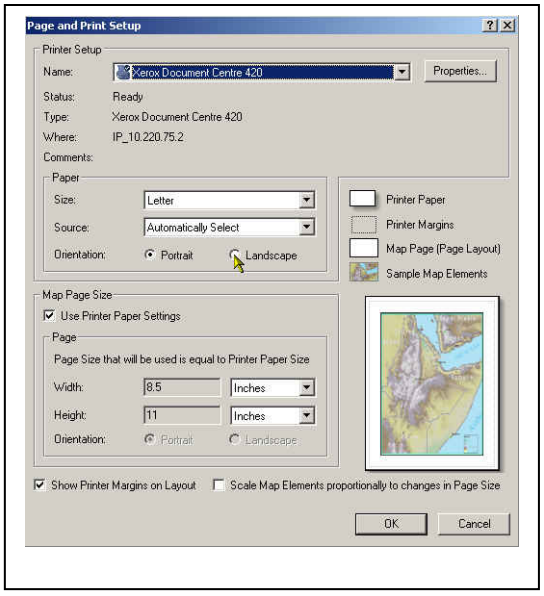


c. Click on the right button that says “layout view”

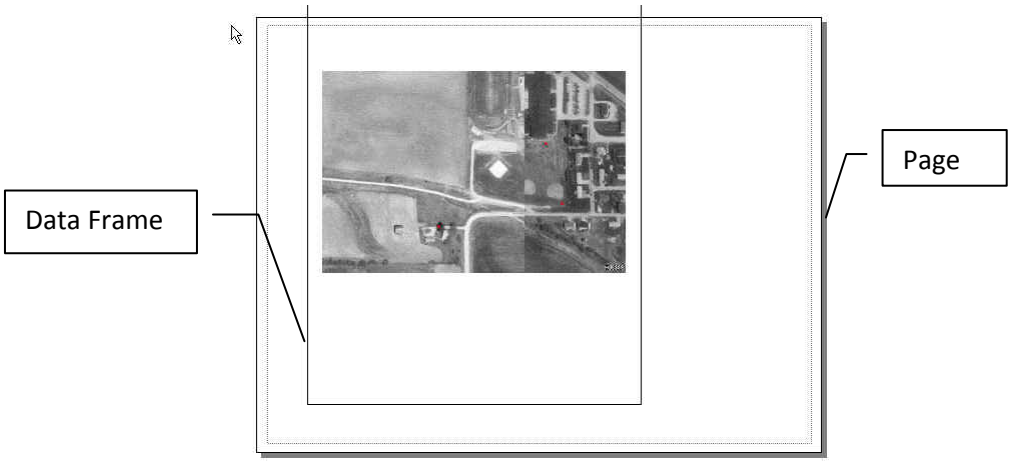
d. This will open a screen that shows a representation of a piece of paper with an identical view from the “data view” . Note that when you switch to Data view the Layout toolbar is activated.



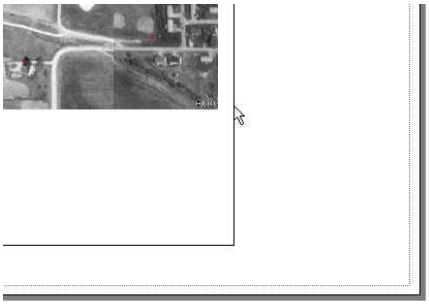
2. Adjust the map on the page
    a. For this map a “landscape” page would work better (because the map is more horizontal). In the menu bar, select “File”, then “Page and Print Setup”.

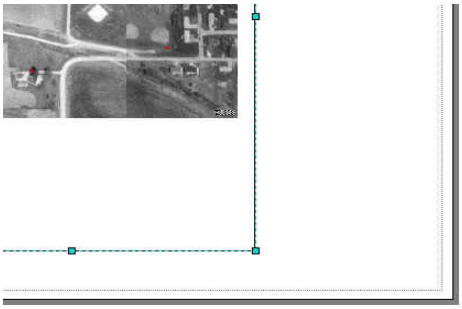


b. Click on the “Landscape” choice and then OK to accept

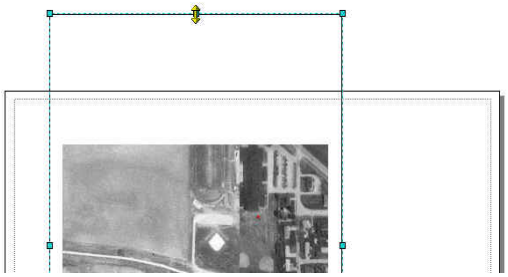


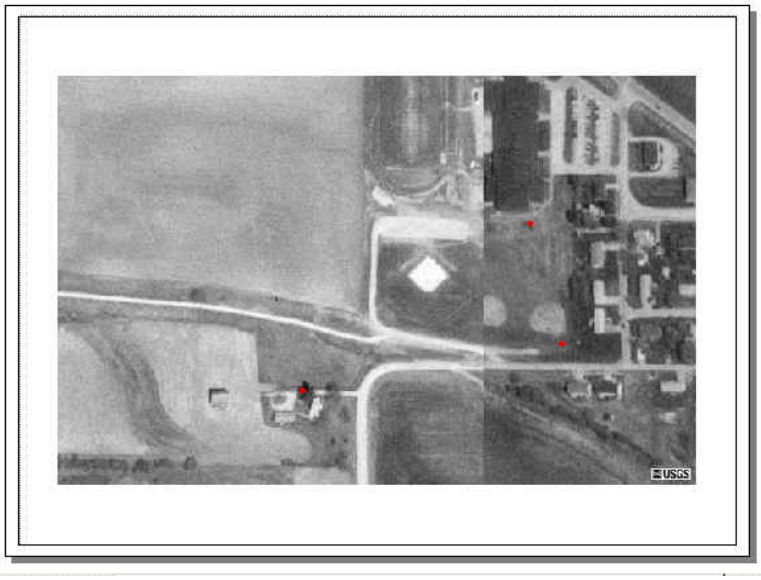
c. This changes the page to landscape but the data frame that contains the map is still portrait. The data frame must be adjusted to the page.
d. Point to the data frame box (as in left figure below) and click on the line. This will highlight the frame (as in right figure below)



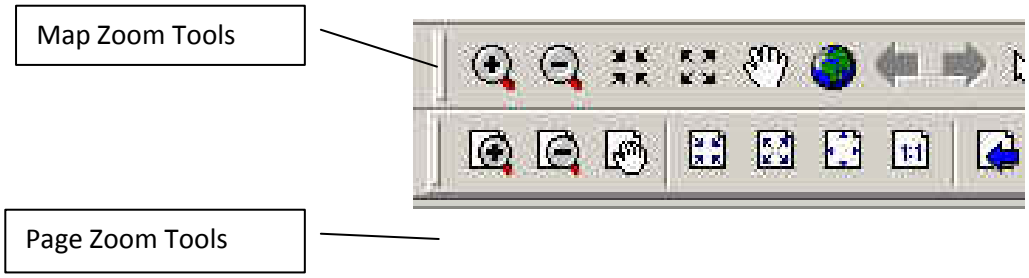


e. Point to one of the highlighted frame edit points until you get a 2 arrow cursor. Click and hold to adjust size of frame to fit the page.





f. Use zoom tools to size and position the map within the data frame. The map tools adjust the map within the page, while the page tools adjust the size of the page



g. It is recommended that you use the following zoom tools:

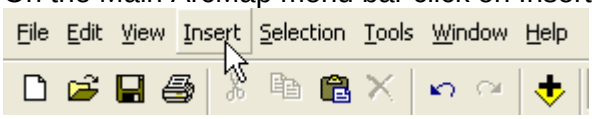
i. Map zoom in - to zoom into a specific area of the map (page will stay the same size) by clicking, holding left mouse button and dragging over the area to be zoomed into

ii. Page Zoom in – to zoom into a specific area on the page (page will appear to get larger)

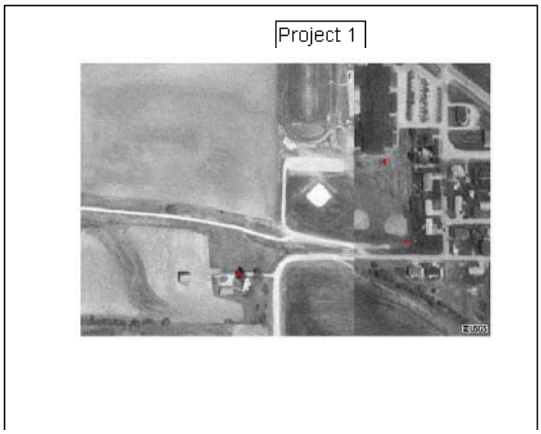
iii. Map Fixed Zoom out – to zoom out of the map by clicking on this button. (page will stay the same size

iv. Page Fixed Zoom out – to zoom out of the page (page will appear to get smaller)

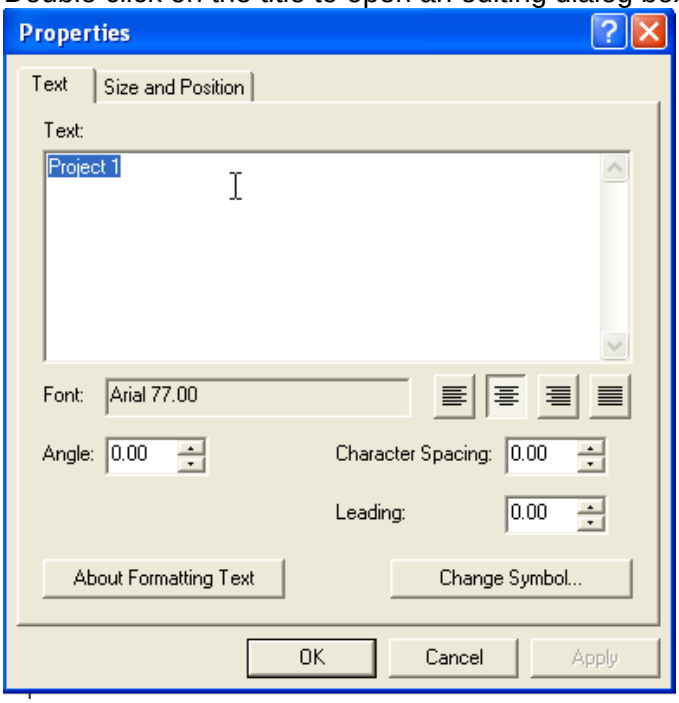
3. Insert map components
    a. On the Main ArcMap menu bar click on Insert and select title



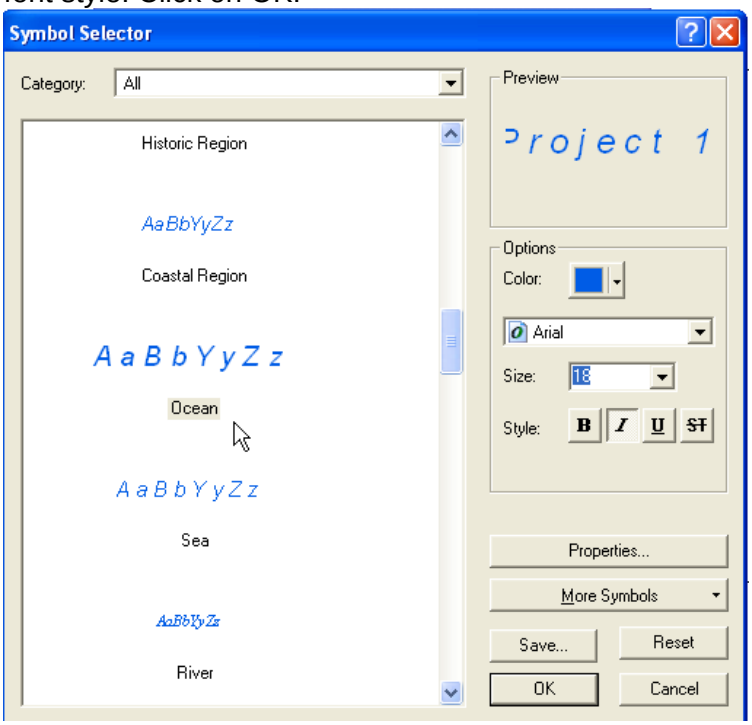
        i. Type in a title of the map; name it after the features collected data on and the area where the objects are located (shown here with the label “Project 1”). Press enter.



ii. Double click on the title to open an editing dialog box. Edit title as needed



iii. Click on the button that says “change symbol”. Select font size, color and font style. Click on OK.

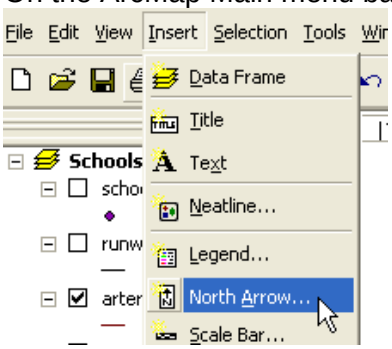


iv. Click and hold on title to move title to appropriate area of map

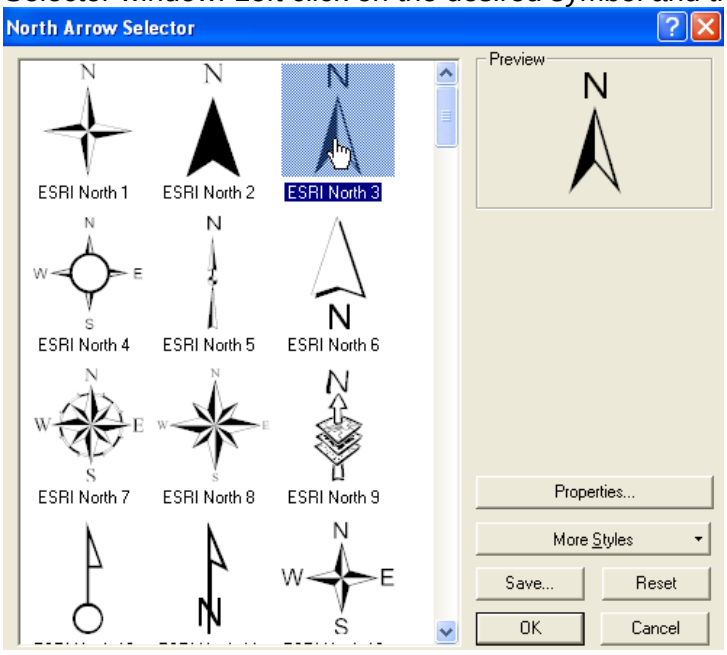
b. On the menu bar click on “Insert” and select “Text” – note as shown in the image below that the text box appeared very small and on the center of the map, just above the cursor. Zoom in to be able to type more easily in the textbox if your textbox also appears very small. The size of the textbox will be related to the drawing scale and can be adjusted as needed.

i. Type in name(s) of students creating map. Press enter.
ii. Double click on the text to open an editing dialog box. Edit text as needed (same procedure as 3.a.ii above)
iii. Click on the button that says “change symbol”. Select font size, color and font style. Click on OK
iv. Click and hold on title to move title to appropriate area of map

c. On the ArcMap Main menu bar click on Insert and select “North arrow”

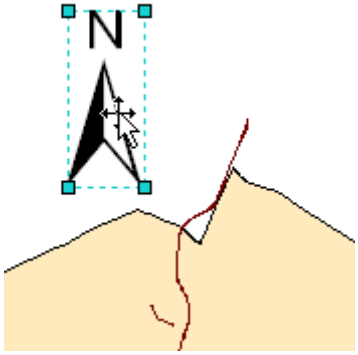


i. Select an appropriate symbol to show direction from the North Arrow Selector window. Left click on the desired symbol and then click OK

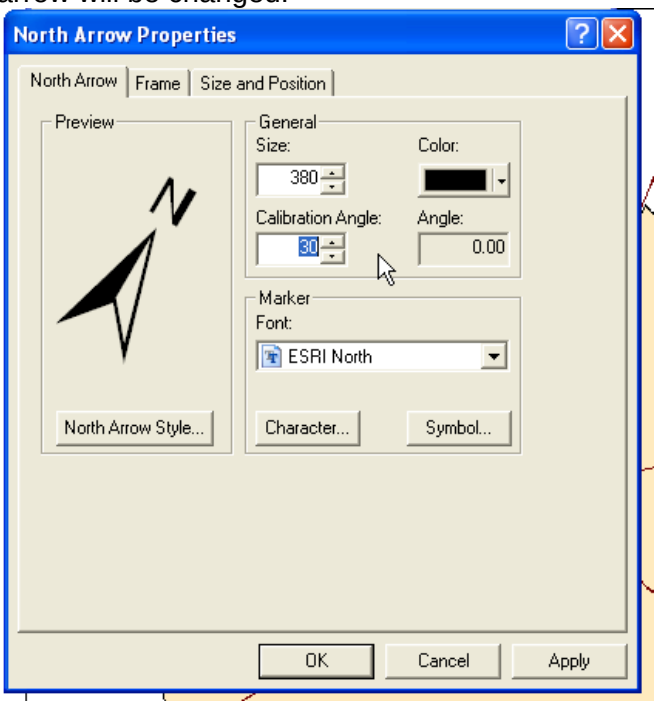


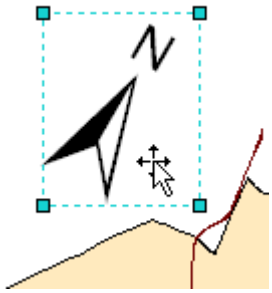
ii. Click and hold on north arrow to move to an appropriate area of map

iii. Click on the border of the north arrow to resize



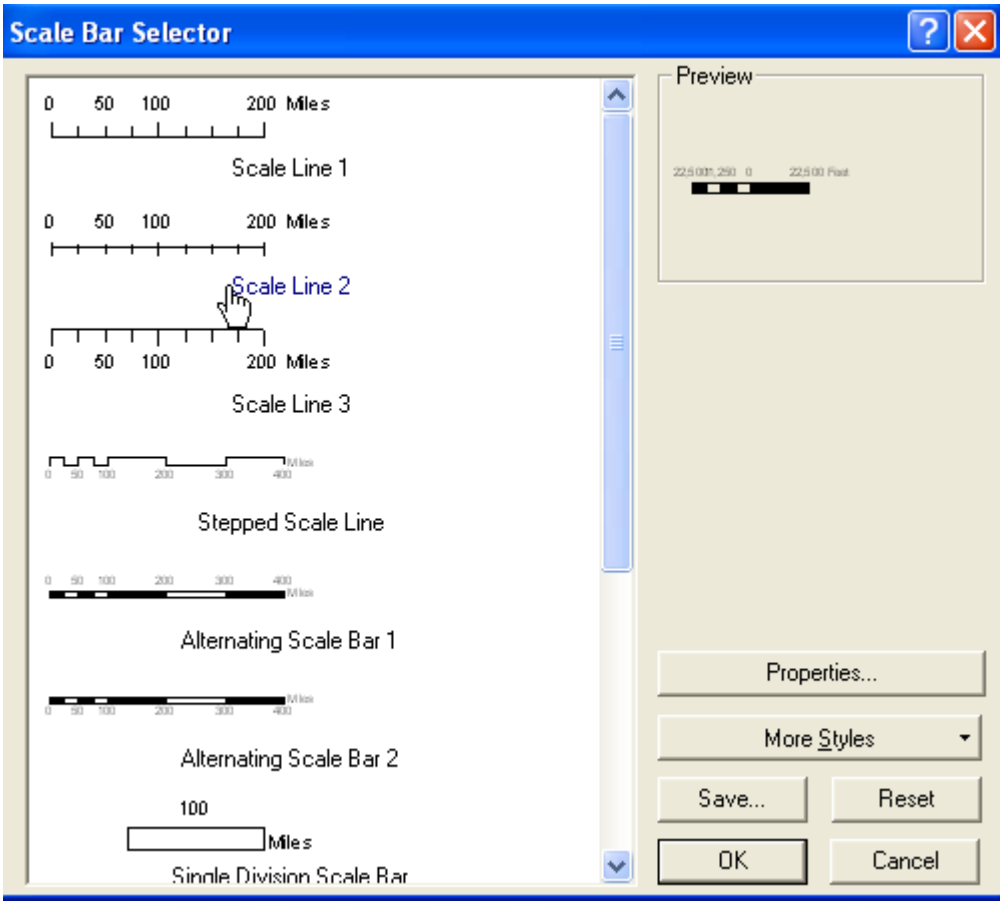
iv. If you want to change the angle of the North Arrow (the default is to have north pointing up), double click on the North arrow to open the North Arrow Properties window. You can enter the desired angle for North as shown. Click apply and OK when done and the direction of your North arrow will be changed.



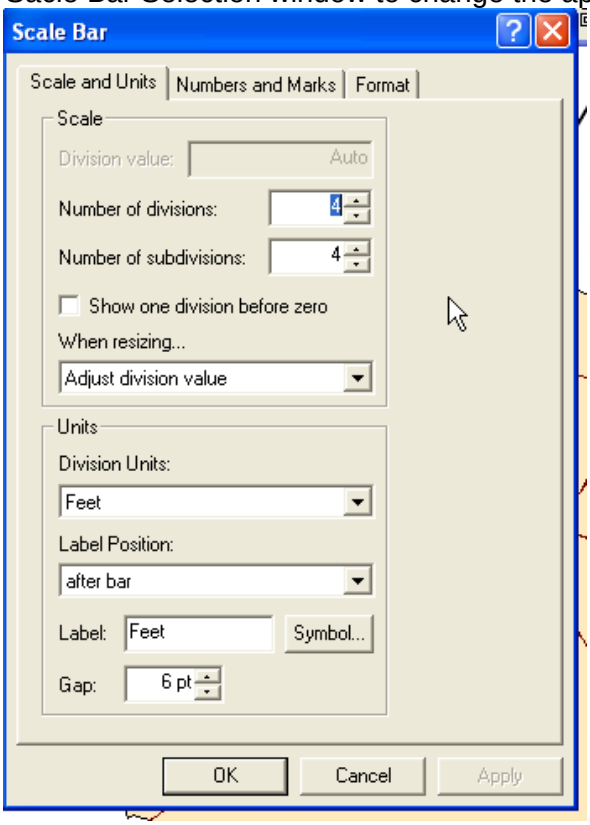


d. On the ArcMap Main Menu bar click on Insert and select “scale bar”

i. Select an appropriate symbol to show scale from the Scale Bar Selector Window.

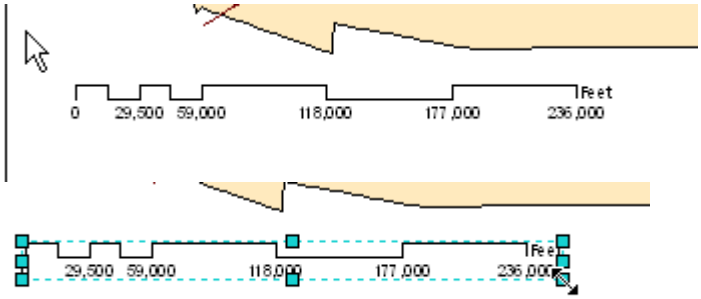


ii. After clicking on your desired scale bar to select it you can click on properties in the Sacle Bar Selection window to change the appearance of the scale bar.



iii. Click and hold on scale bar to move to an appropriate area of map

iv. Click on the border of the scale bar to resize it if needed.



e. You can also change the appearance of the Map Border:

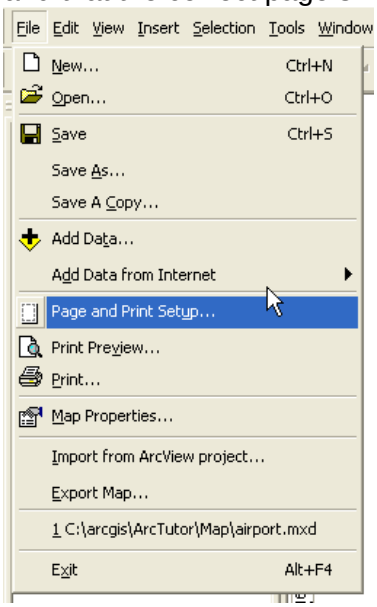
i. Be sure you have the Selection Tool (black arrow) activated and left click on the border to select it.

ii. Use the edit tools found on the bottom of the Map Layout window to change the color of the border or to apply a fill color.

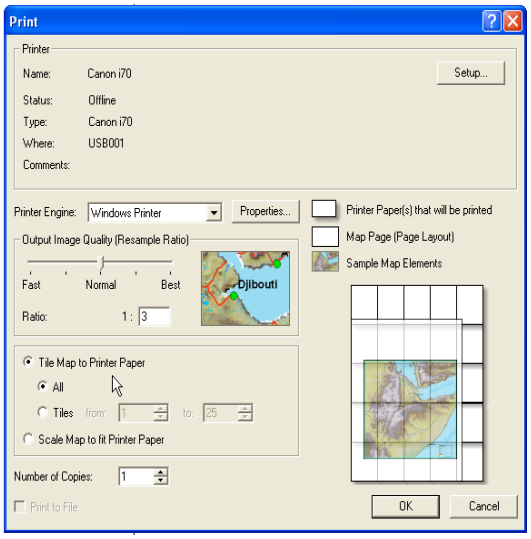
4. When you are satisfied with the appearance of you map you are ready to print out a map

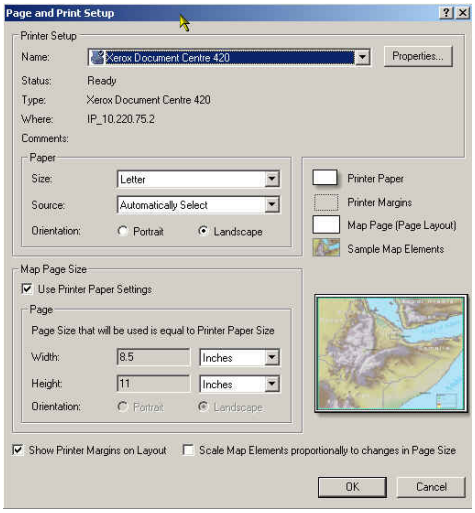
a. From the ArcMap Main menu bar select “File” and then “print”

b. This opens up a print dialog box. Make sure that the correct printer is selected and that the correct page size and the correct page orientation has been selected

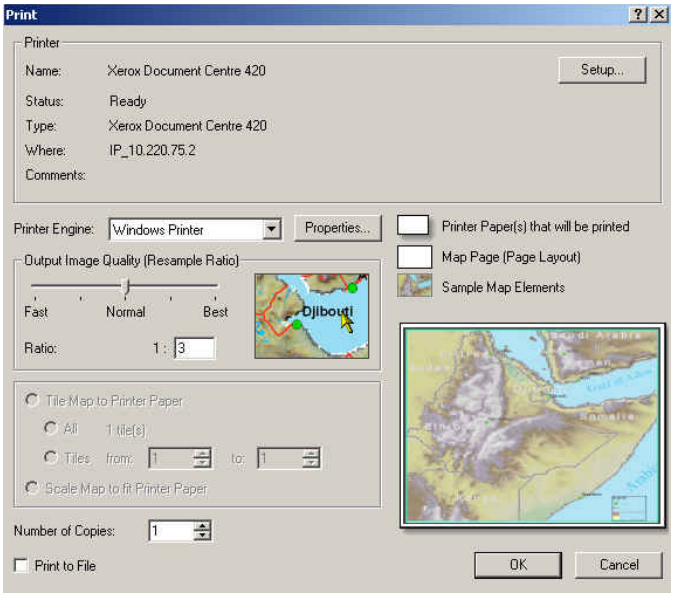


c. It is very important that you double check the output size. In the image capture shown below left, this Map would print "tiled" – that is it will print by printing just a small part on the map on each of 25 sheets of 8.5 x 11 paper. Within Print Setup select "scale map to printer paper" or select "letter" for size, as in below right (depends on the printer selected)





d. When you are satisfied with the print preview click on OK. To print, from the menu bar click on “File”, then “Print”. Check to make sure setup is still correct and then press OK button to print.



5. Save all changes to your map document

Summary

The students now have a finished project and a paper map to show for it. This completes the Data Collection Module. The students were able to collect field data with a simple GPS receiver, find and use an aerial photo from the internet, add them as data layers to a GIS, and create a final map. Though this is a simplified example using simple tools, it duplicates the some of the processes that are use in a geospatial career.

To follow up with this lesson it is recommended that the students use a agricultural data collection system such as FieldDoc within the Deere GreenStar. A local farmer, community college instructor, or John Deere dealership could be contacted for such a demonstration and possibly a hands-on activity.

Regional Workshops

Geospatial Series

Introduction to Data Collection

Assessment Test

1. Which term refers to a point to which a person is navigating?

A. navigation point
B. goto location
C. waypoint

2. A characteristic about some mapped object is referred to as:

A. data
B. an attribute
C. information

3. Which of the following ESRI product is used to create a new empty table for data?

A. ArcCatalog
B. ArcMap
C. ArcEditor
D. ArcInfo

4. Which of the following functions is a function of GIS?

A. controlling
B. sensing
C. calculate location
D. data editing

5. In order to use the data collected in the field in a GIS it must have:

A. ID value
B. source data
C. X Y coordinates
D. shapefile

6. How do you get a data layer to display in ArcView data view?

A. make sure the data layer is checked
B. add it to the bottom of the table of contents
C. highlight it
D. double click on the name

7. What are the PROPER terms to describe the structure of a table in ArcView?

A. columns and rows
B. fields and records
C. pixels and cells
D. items and wickets

8. What value does the navigation function have in data collection?

A. prevents the user from getting lost in the field
B. allows the user to use the four wheeler /ATV to collect data
C. allows the user to find a specific location of interest in order to collect data

9. The spatial reference of a data layer refers to _____

A. the size and location of the data layer

B. the approximate street address location of the data layer

C. the coordinate system and datum used by the data layer

D. the location of the data layer shapefile on your computer

10. The X Y coordinate of an object can be referred to as _____

A. locational data

B. attribute data

AgrowKnowledge
The National Center for Agriscience & Technology Education

GPS/GIS for Agriculture Applications
Faculty Development Workshop
Evaluation

Instructions: Please use the following 5-point scale to evaluate general aspects of the workshop, the information presented for each workshop topic, and the various workshop activities. Check the box that corresponds to your rating.

	Poor	Below Average	Average	Above Average	
General Aspects:					
1. Clarity of workshop objectives	☐	☐	☐	☐	☐
2. Organization of the workshop	☐	☐	☐	☐	☐
3. Effective use of time	☐	☐	☐	☐	☐
4. Applicability of information	☐	☐	☐	☐	☐
5. Resources and materials	☐	☐	☐	☐	☐
6. Interaction among participants	☐	☐	☐	☐	☐
7. Effectiveness of speakers	☐	☐	☐	☐	☐
8. Overall rating of the workshop	☐	☐	☐	☐	☐
Workshop Topics:					
9. Location Exercise	☐	☐	☐	☐	☐
10. Navigation Exercise	☐	☐	☐	☐	☐
11. Datalogging Exercise	☐	☐	☐	☐	☐
12. Building a GIS table	☐	☐	☐	☐	☐
13. Building a GIS project map	☐	☐	☐	☐	☐
14. Adding XY data	☐	☐	☐	☐	☐
15. Creating final map	☐	☐	☐	☐	☐

Please respond to the following open-ended questions.

16. Which aspects of the workshop were most useful to you and why?

17. List two ways you will use the information from this workshop in your classroom.

18. Please provide suggestions for improving the workshop.

19. Additional comments about the workshop.

Thank you for completing this survey!

Regional Workshops

Geospatial Series

Introduction to Data Collection

Appendix: PowerPoints

Introduction to GPS/GIS Ag Applications

"Name of Host College"
"Location"
"Dates"
presented by
AgrowKnowledge, The National Center for Agriscience and Technology Education

AgrowKnowledge

- The National Center for Agriscience and Technology Education
- Partly funded by the National Science Foundation
- Mission: to prepare a technologically advanced workforce in ag industry
- Enhance science, math and technology in technician programs

Instructors / Facilitators

- Name of Facilitator,
  - Title and College
- Name of Assistant,
  - Title and College

Workshop effectiveness

- Content test
  - 10 questions
  - Multiple choice
  - Covers workshop topics
- Post workshop
  - Content test – post
  - Evaluation

Objectives

Upon completing this workshop participants will be able to:

- Use a GPS receiver to collect waypoints
- Collect simple feature information and attribute data
- Transfer data and display it in a GIS
- Understand the value of spatial data for a manager

Content

- Review of Geospatial technologies
- Overview – Applications of geospatial tools
- Location exercise - use of GPS to determine location
- Navigation exercise – use of GPS to navigate to a location
- Datalogging exercise – use of GPS to collect data on objects
- Transferring data between GPS and computer
- Building a spreadsheet for data
- ArcView - basics; Components of a GIS
- Building a simple project
- Adding an event theme – Import data spreadsheet into ArcView
- Sharing data layers – Exporting data to shapefile format and sharing with other participants.
- Creating a map – each participant will create a map with background data and data from other participants
- Use of ArcExplorer /ArcReader – alternatives to using ArcView

Post workshop

- Building instruction material
  - Lesson plan for participant's school
  - Enhanced powerpoints
  - Ideas for learning objects
  - Integration into science, math or other non-ag classroom

Introduction to Geospatial Technologies in Ag

Introduction to Precision Farming
Ag Geospatial Program of Study

This project is partly funded by the National Science Foundation. Any opinions expressed within are those of the authors and not necessarily those of the Foundation.

Overview

- Tools of Precision Farming
- Processes of Precision Farming
- Uses of Precision Farming
- Benefits of Precision Farming

Tools of Precision Farming

- Global Positioning System (GPS)
- Geographic Information Systems (GIS)
- Intelligent Devices and Implements (IDI)

GPS tutorial websites

- http://tycho.usno.navy.mil/gps.html
- http://www.trimble.com/gps/index.html
- http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html
- http://www.navcen.uscg.gov/

Global Positioning System

- Global Navigational Satellite System for the U
- Composed of:
  - Satellite constellation (31 satellites)
  - User based receiver units
- Satellites transmit one way ranging signals which the receivers use to calculate a location
- Accurate latitude/longitude to 10 – 30 feet
- Correction to submeter to subinch possible

GPS – User Segment

- **Components**
  - **Antenna**
  - **Receiver**
  - **Display**
  - **Firmware**
  - **Input**

Graphic from http://www.trimble.com/geoexplorer3.html

GPS – basic information

- Location – specific coordinates to identify your position within 10 – 30 ft
- Time – using the atomic clock, a very precise time that an event occurred can be determined
- Speed – by calculating continuous positions, your speed can be calculated
- Direction – by calculating continuous positions, your direction of travel can be determined.

GPS – Ag Applications

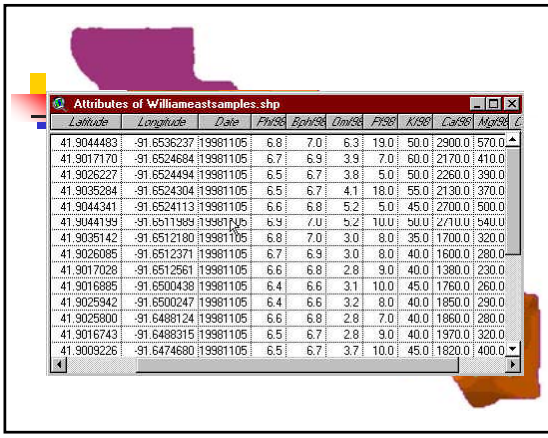
- Determine location
- Navigate to a known coordinate point
- Data logging
- Data Logging is most valuable use in ag
  - Combined with yield monitor for yield mapping
  - Used in scouting to create scout maps
  - Used to distribute and record variable rate products
  - Used to georeference soil sampling

Tools of Precision Farming - GIS?

- Computerized Map
- Combines a map with database information about each feature on the map
- Analyze information about feature

Components of a GIS

- **Map** – displays reference and thematic map layers.
  - Each map layer has one type of feature
  - Map layer can have from 1 to thousands of that feature
  - Map layers can be grouped together
- **Table** – stores and manipulates data about features in map layers
  - Looks most like a spreadsheet
  - Each feature on a map has one row in the table
  - Attributes of each feature is stored in columns
- Table and Map are digitally connected

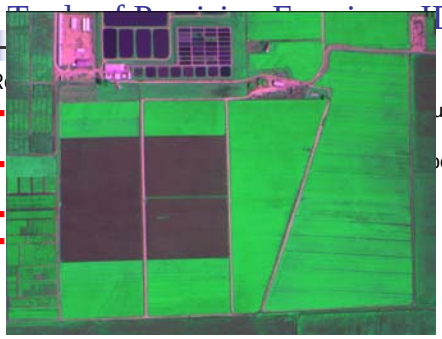


Functions of a GIS

- Viewing mapped features
- Storage of data
- Retrieval of data - Query
- Analyze data
- Manipulation of data/information
- Presentation of information

Tools of Precision Farming – IDI

- R
  - us
  - be



Processes of Precision Farming

- Data Collection (builds data)
- Data Analysis (creates information)
- Interpretation (uses information for decision making or implementation)
- Duplicates the decision making process

How are the tools used?

- Data collection
  - Georeference data to a map - GPS
  - Manage and display data - GIS
  - Sensors to measure and sense soils or conditions - IDI
- Data Analysis
  - Statistical Summary - GIS
  - Query objects and areas of interest - GIS
- Interpretation
  - Spatial records in database - GIS
  - Interpretive maps - GIS

Uses of Precision Farming

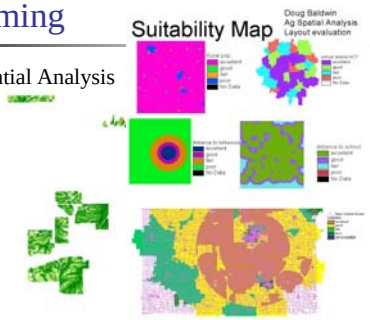
- Variable Rate Application and Guidance
  - Use of tools and analysis to apply correct amounts on fields
- Recordkeeping
  - Use of Precision farming tools to record inventory, production or management
- Spatial Analysis
  - Use of tools and records to analyze records for decision making

End products of Precision Farming

- Recordkeeping

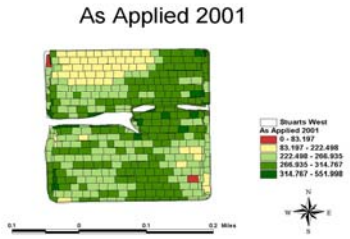
End products of Precision Farming

- Spatial Analysis



End products of Precision Farming

- Variable Applicati



Benefits

- Economic
  - Financial – higher yields/lower inputs
- Environmental
  - Protecting the natural resources
- Sustainability
  - Making decisions that balance both

GPS Exercises

Introduction to GPS/GIS Ag Applications

This project is partly funded by the National Science Foundation. Any opinions expressed within are those of the authors and not necessarily those of the Foundation.

Garmin Etrex

Location Exercise

- Objectives:
  - Basic use of GPS receiver - setup
  - Awareness of coordinate systems
- Materials:
  - Worksheet
  - GPS receiver
- Assignment
  - Select and record the coordinates of a series of objects
  - Record the coordinates of the objects using different coordinate systems
  - Save coordinates as waypoints

Location Exercise

- Any object of students choice
  - Developing spatial awareness
- Coordinates
  - DD – Decimal Degrees 42.675849°
  - DM – Degrees Minutes 42° 34.5675'
  - DMS – Degrees, Minutes, Seconds 42° 34' 23.5"
  - UTM – Northing ^{47}23 484.45

Location Exercise

- Setup of Coordinate Format
  - Setup/menu page
  - Select Units
  - Format, select hdd.ddddd(decimal degree)
- Use of input buttons
  - Arrows to move around screen
  - Enter to select highlighted option
  - Page to exit screen after selecting

Navigation

- Materials
  - Worksheet
  - GPS Receiver
- Assignment
  - Use waypoints saved from Location exercise or enter waypoints into receiver
  - Start and use navigation page
  - Follow navigation instructions to waypoint

Navigation

- What value does this have in agriculture?
  - Find soil sample location assuring random or statistically correct sampling
  - Find abnormal conditions in field
  - Finding a previous treatment area for comparison

Datalogging

- Materials:
  - Worksheet
  - GPS Receiver
- Assignment:
  - record coordinates for three of the same type of object
  - Determine two attributes to be collected for each object
  - record data values for each attribute on each object

Datalogging

- What value does this have in agriculture?
  - Yield monitoring/mapping
  - Crop scouting/pest mapping
  - Recording of characteristics and conditions
  - Placement of crop inputs

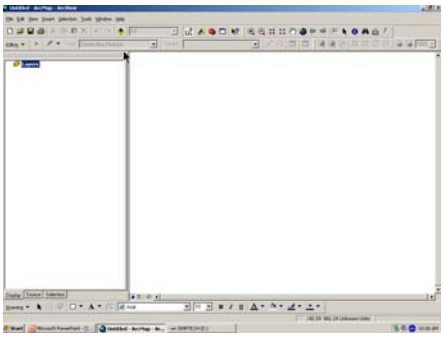
Applications Exercise

- Research ways in which GPS is used
- Write one paragraph summary and present to class
- Weirdest use of GPS
- Best use of GPS

GIS Exercises

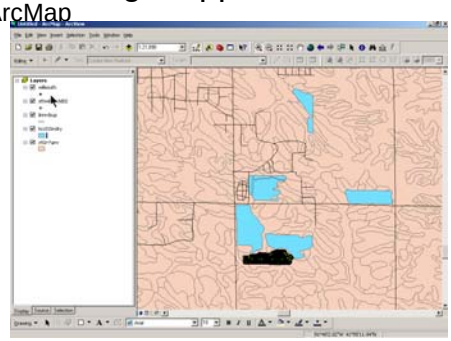
Introduction to GPS/GIS Ag Applications

ArcGIS ArcView 9, ArcMap



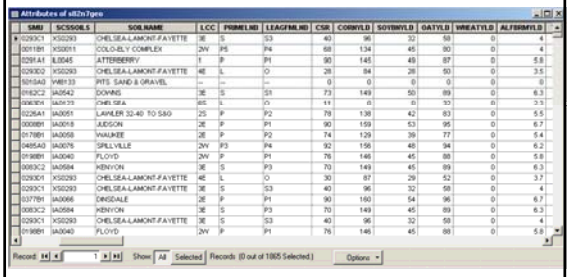
Viewing mapped features

- ArcMap



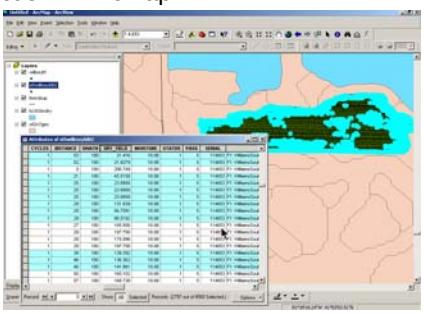
Storage of data

- Table in ArcMap



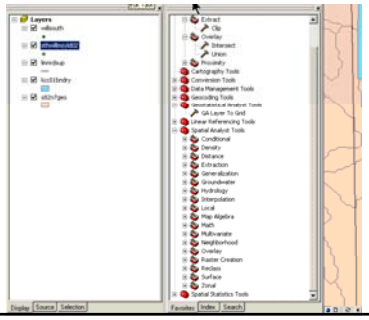
Retrieval of data - Query

- Selection in ArcMap



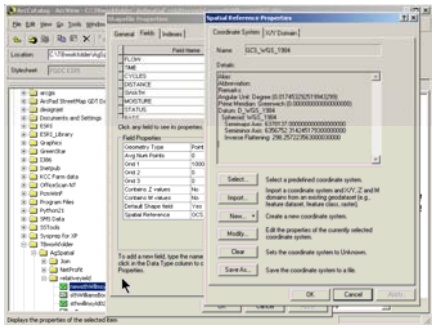
Analyze data

- Toolbox in ArcMap



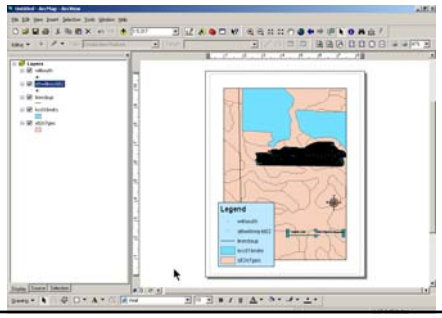
Manipulation of data/information

- Toolbox in ArcCatalog



Presentation of information

- Layout in ArcMap



Parts of the ArcMap Interface

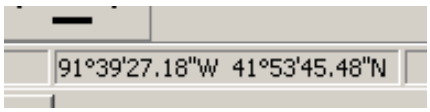
- Menu bar
  - contains commands for most ArcView functions
  - divided into standard Windows functions
  - Different for each

Parts of the ArcMap Interface

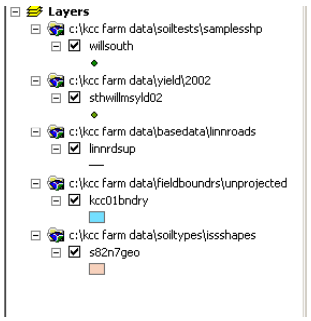
- Toolbar
  - Buttons - work by clicking on once for task
  - Tools - work by clicking on to turn tool and then using mouse to complete task

Parts of the ArcMap Interface

- Status



ArcMap Project



Practice building a table

Northing	Easting
414564.85	382168.69
414378.58	382255.51
414394.78	382328.40
414421.77	382379.69

Projected - State Plane NAD 83 US Feet

GIS Exercise – Building a Project

- Open new map
- Add data layers
- Rename and change symbology
- Agricultural projects

GIS Exercise – Add XY table

- A. Create a new table
  - Use ArcCatalog to create a new table in designated folder
- B. Add attribute fields
  - Open ArcMap, add table to new project and add fields
- C. Add field data to table
  - From editor toolbar, start editing and enter numbers into table
- D. Add table to ArcView
  - From the menu bar select tool and click on “Add X, Y Data”
- E. Convert to Shapefile
  - Right mouse click on table and select Data/export data
- F. Create a map layout
  - Insert map components to create a professional map

Regional Workshops

Geospatial Series

Introduction to Data Collection

Appendix: Worksheets

Introduction to Data Collection
Prerequisite Knowledge, GPS – Determining Location

Teacher Instructions

1. Objectives of exercise:
    a. Become familiar with the setup and use of the GPS unit
    b. Become familiar with different coordinate formats

2. Review GPS using the GPS powerpoints

3. Handout GPS receivers and if students haven't used GPS units before, review using eTrex powerpoint animation
    a. review the process of acquiring satellites and check for accuracy
    b. review instructions for changing the position format
    c. read and record the location of various objects using different coordinate position formats

4. Pair up students and review the worksheet to make sure they understand the directions

5. make sure students are changing the formats and recording the coordinates correctly (in decimal degrees/DD, example - 42.9227364

6. Common mistakes to watch for
    a. recording a latitude coordinate in the longitude column
    b. recording coordinate in something else besides decimal degrees
    c. forgetting the minus (-) sign when recording longitude

7. when completed review and hand-in sheets for grading

Introduction to Data Collection
Prerequisite Knowledge, GPS – Determining Location

Student Worksheet

GPS Receiver # _____

Error estimate _____

Group Members

_____

_____

Instructions:

1. Divide into pairs.
2. Each person in the pair will select 4 objects for which to record a location.
3. Record the coordinates and type of object in the appropriate columns.
4. For each object, a different coordinate format will be used (as noted in the last column)
5. Use the setup menu to change the coordinate format displayed by your GPS unit.

Record the location of objects in the boxes below

Person-object	Latitude/Northing	Longitude/Easting	Object/Feature	Format
1 – 1				DD
1 - 2				DM
1 - 3				DMS
1 - 4				UTM
2 – 1				DD
2 - 2				DM
2 - 3				DMS
2 - 4				UTM

Changing the position format

Garmin eTrex

1. Turn on unit
2. Press page until menu screen is displayed
3. press down until Setup is highlighted; press enter
4. press down until position format is highlighted; press enter
5. press down or up until the intended coordinate position format is highlighted
6. press enter to select
7. press page to exit to setup menu, press page again to exit to menu screen

Introduction to Data Collection
Prerequisite Knowledge, GPS - Navigation with Waypoints
Teacher Instructions

Goals:

Upon completion of this lab activity students will

- be able to navigate to waypoints

Objectives:

Upon completion of this activity, students will

- describe the use of a waypoint in navigation
- demonstrate ability to enter a waypoint into a GPS unit
- demonstrate ability to navigate to a waypoint

Materials:

- Handheld GPS receiver(s)
- Student worksheets

Instructions:

1. Using a USGS topo map for your area, pick out two specific objects that students want to navigate to. Determine the latitude/longitude coordinate of each. (Alternately, instructor selects two objects and provides the coordinates to the students. In this method the students do not know where they are going and must rely entirely on GPS)

2. Assign and handout GPS receivers to groups of students

3. Review with the class what a waypoint is and how to set a waypoint.
   a) In most systems, waypoints can be entered by pressing the page button until the Main Menu page is displayed and then selecting "waypoint" Arrow keys are used to enter coordinates. Use Garmin eTrex animation for practice in setting waypoints. When printing out student worksheet make sure and include step by step GPS instructions on back page.
   b) Enter both waypoints into GPS unit

4. Go outside, acquire satellites and demonstrate setting your current position as a waypoint (students should be standing in a specific spot, to check accuracy on the return). Garmin eTrex animation can be used previously for practice in setting current position as a waypoints.

5. Review the procedure for navigating to a waypoint using the navigation screen. Garmin eTrex animation can be used previously for practice in using the navigation

screen. Start navigation to the first waypoint. Review with the students what they are seeing on the screen and that they must follow the navigation arrow.

6. Have students use the navigation screen to navigate to the first point determined from the USGS topo map. (Note: Do NOT make the first person to the location a factor of evaluation, it tends to promote racing)

7. Meet at the first waypoint and compare accuracy (students are not all close to the feature because of the accuracy of the GPS and the accuracy by which the coordinates were determined). Navigate to the next location; meet and discuss the difficulties in finding the object. Navigate to the original starting waypoint that they set at the start of class.

8. Discuss
   - differences in methods of navigation
   - methods of setting waypoints
   - accuracy with which waypoint is found

Grading:

Students will turn in a lab report giving procedures, successes and problems.

Lab Report Rubric	100 – 90%	89 – 80%	79 – 70%	69 – 60%
Completeness	Description of activities is detailed and complete	Description of activities is missing some details but includes all steps	Description of activities is missing specific steps.	Description of activities is limited to an outline or list with no detail.
Quality work	Report is typed or computer generated. It is easy to read and easily identifiable.	Report is typed or computer generated. It lacks in appearance	Report is handwritten and lacks in overall appearance	Report handwritten and hard to read. No attempt to correct for spelling or grammar
Timeliness	Report is on time	Report is one day late	Report is one week late	Report is turned in at end of the semester
Group work	All members are involved and participate	Some members are involved and participate	One member does most of the work	One member does all of the work

Prerequisite Knowledge, GPS - Navigation with Waypoints
Student Worksheet

Objectives:

Upon completion of this lab activity, students will have

- used two different methods to set waypoints
- used waypoint set in a GPS units to navigate to an object.

Instructions:

1. Divide into groups of 4. Make sure that one person has a vehicle available to drive. Get a GPS receiver from your instructor. (step by step instructions on back page)

2. Using a USGS topo map for your area, select two specific objects to practice navigation techniques or get two points from your instructor.

   1st waypoint object _____
   Latitude _____
   Longitude _____

   2nd waypoint object _____
   Latitude _____
   Longitude _____

3. Enter the above waypoints into your GPS unit. (use instructions on back page)

4. Go outside and acquire satellites. Mark your current position as a waypoint.

5. Review the procedure for navigating to a waypoint using the navigation screen. Make sure that you understand how it is done before leaving for the first waypoint.

6. All students must meet at the first waypoint object. Please do not race to the waypoints, this is not a race! Discuss accuracy with which object was found.

7. Navigate to the second point object. Discuss accuracy.

8. Navigate to the original marked waypoint back at school.

GPS Instructions for Garmin eTrex

Enter a coordinate position

1. Turn on GPS unit
2. Press *page* to go to menu screen
3. Mark waypoint will be highlighted. Press *enter*
4. Waypoint screen will be shown. Press *down* until position is highlighted. Press *enter*
5. Coordinates will be highlighted. To change the waypoint coordinates:
    a. press *down* to move to a digit that needs to be changed
    b. press *enter* to edit digit
    c. press *down* or *up* to change digit
    d. press *enter* to select correct digit and move to next digit
6. When correct coordinate has been entered, press *down* to highlight "save". Press *enter*

Change name of waypoint

7. Press *down* or *up* to highlight name on flag
8. press *enter* to edit
9. press *down* or *up* to change the digit or letter in name
10. press *enter* to select correct digit or letter
11. press *enter* when completed with name to save

Use a waypoint for navigation

12. from the menu screen, press *down* to highlight waypoint list; press *enter*
13. waypoint list is displayed. Press *down* or *up* to highlight correct group of waypoints; press *enter*
14. waypoints will be listed. press *down* or *up* to highlight one specific waypoint; press *enter*
15. waypoint page is shown; press *down* to highlight "GoTo"; press *enter*
16. Navigation screen is displayed. Circle is compass showing direction you are actually moving (heading). Large black arrow is direction to the waypoint (bearing)
17. Start moving one direction until GPS calculates your direction, then follow the arrow.

Introduction to Data Collection
Lesson 1 – Collecting Waypoints
Sample Projects

Listed below are examples of projects that can be used for the Introduction to Data Collection Curriculum. Projects allow students to work together as a team; groups of students collect points on different objects within the project. This is not a comprehensive list of all projects, objects and attributes that can be done, but are offered as examples. Allow students to be creative and select objects they want to map and to determine attributes of those objects.

1. Project: farm field
    a. Objects: soil samples
        i. Attributes: sample number
        ii. Attributes: sampler
        iii. Attributes: Data sample taken
        iv. Attributes: field number/name
    b. Objects: weed points
        i. Attributes: type of weed
        ii. Attributes: species of weed
    c. Object: wet points
        i. Attributes: field number
        ii. Attributes: date

2. Project: golf course
    a. Objects: tee-offs
        i. Attributes: hole#
        ii. Attributes: men's or women's
    b. Objects: holes
        i. Attributes: Hole #
        ii. Attributes: condition

3. Project: school grounds
    a. Objects: signs
        i. Attributes: type
        ii. Attributes: height
    b. Objects: Light posts
        i. Attributes: number of bulbs
        ii. Attributes: height
    c. Objects: bus-stops
        i. Attributes: covered?
        ii. Attributes: bench?

4. Project: Plant ID
    a. Objects: Trees
        i. Attributes: condition
        ii. Attributes: species
    b. Objects: Shrubs
        i. Attributes: flowering color
        ii. Attributes: species
    c. Objects: Plants
        i. Attributes: species
        ii. Attributes: planting date

5. Project: park
    a. Objects: shelters
        i. Attributes: size
        ii. Attributes: fireplace?
    b. Objects: Monuments
        i. Attributes: name
        ii. Attributes: condition
    c. Objects: points of interest
        i. Attributes: type
        ii. Attributes: description

Introduction to Data Collection
Lesson 1 - Collecting Waypoints

Group # _____ GPS Receiver # _____

Group Members

_____

Object Type : _____

Group members will decide on one type of object on which to collect data.
Group members will decide on **two** characteristics of that object which might be important for a person managing that object to know
List the characteristics on the top heading row
Each group member must:

-find **four** of the objects and use GPS to calculate their coordinate position,
-record its latitude/longitude in decimal degrees in the worksheet below
- determine and record a data value for each characteristic.

#	Latitude (DD)	Longitude (DD)				
1						
2						
3						
4						
5						
6						
7						
8						

Introduction to Data Collection
Lesson 1 - Collecting Waypoints

Instructor Instructions and exercise example

Number of Groups _____

Divide class into groups of 2 – 3
Let groups decide on one type of object and the two (or more) characteristics of that type of object. Use the project examples to provide some examples.
Decide how many objects each student must find and record (4 – 8 suggested)
Make sure that students know how to find coordinates on GPS unit and that they are recording them in decimal degrees.
Provide the example for a person in a group doing fire hydrants.

#	Latitude (DD)	Longitude (DD)	Object/Feature	EX. Nbr of outlets	EX - color	EX – Code #
Ex1	41.983726	-91.567343	Fire Hydrant	2	Yellow	83736
2	41.678353	-91.583736	Fire Hydrant	3	red	83617
3						
4						
5						
6						
7						
8						

Introduction to Data Collection
Lesson 3 - Finding data for your state
Teacher Instructions

Background

Each state should have an information council which may have a clearinghouse of GIS data that is free for download. Providing instructions for every state's clearinghouse is beyond the scope of this lesson. However, with some basic instructions and hints, anybody should be able to find free GIS data.

1. Search internet
    a. Use a familiar search engine such as Google (www.google.com)
    b. Enter keywords to begin search, listed below are suggestions
        i. "GIS data"
        ii. "Information council"
        iii. Name of your state
        iv. "download"
    c. Use advanced functions such "search within results" to narrow down choices

2. Select from search results
    a. Look for websites that have a . gov or a .org address
    b. Look for website that includes your state's name with geographic information council
    c. Click on the links for these websites

3. Review website
    a. On the information council's website, look for links that say:
        i. clearinghouse
        ii. downloadable data
        iii. search for data

4. Downloadable data
    a. Check to make sure there is a working link to the data
    b. A good link will provide a dialog box that allows you to browse to a specific drive and folder to download and save the data

5. If the website is good for data, save as a favorite!

Introduction to Data Collection
Lesson 3 – Adding Data to ArcMap
Subject: Preparing and using Terraserver images with ArcVoyager

This activity was originally created by Dan Harms and adapted for use with the Introduction to Data Collection curriculum module

Teacher Instructions

(Note this study guide is written for ArcVoyager Special Edition, installed on a system without an ArcView installation. ArcVoyager on a workstation with ArcView 3.x may enable the user to view a wider variety of image file formats. If ArcExplorer or another GIS is being used the images may be saved as jpg with a jpw world file.)

Objectives:

Upon completing this study guide you should be able to:

1. Identify the types of data available from Terraserver.
2. Download images from Terraserver
3. Identify the file format for raster data viewable in ArcVoyager
4. Create a world file for aligning the data in ArcVoyager.
5. Create metadata for the downloaded data.

Skills to review:

To successfully complete this study guide, you should be able to:

1. Browse the Internet
2. Use a search function on an Internet webpage.
3. Create folders on a computer storage device.

4. Browse your computer (Windows Explorer) to a specific folder.
5. Use “Cut & Paste” techniques.
6. Access and use a text editor like Notepad.
7. Save files.
8. Rename files.
9. Create a new project in ArcVoyager
10. Load and view layers in ArcVoyager

You will need:

Internet access.

Rights to save and edit files to a computer storage device

ArcVoyager installed on your workstation.

Access to a color printer.

Introduction:

Raster images are a powerful tool to use in a GIS. Terraserver is a web portal that gives one the ability to download raster images from the entire United States. The data can be identified a number of ways, and can be saved for use in a GIS created in ArcVoyager.

In this project you will access the data and create a series of maps of the Gettysburg National Military Park in Gettysburg Pennsylvania.

Part I: Obtaining and Preparing Data for the GIS

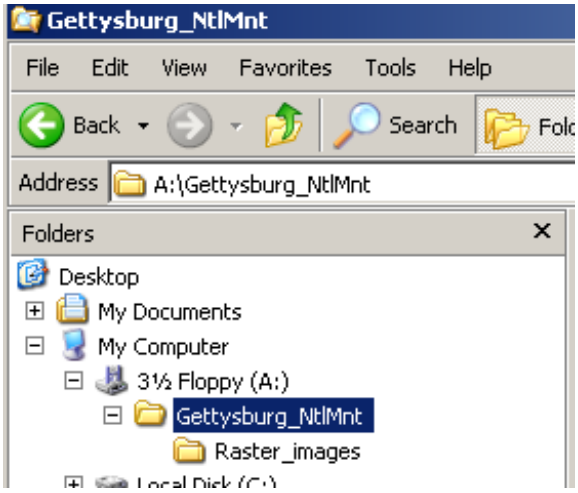
Step 1: Where will I put the data?

Geographic Information Systems are very powerful computer applications that can work with a tremendous amount of data. One of the most important parts of planning a GIS is organizing and understanding where the data is stored and how it is stored.

1. Browse to the device (drive or disk) where you plan to place the data for your GIS.

   (your instructor may specify where this will be)

2. Create a new folder called Gettysburg_Ntlmt
3. In this folder, create a subfolder called Raster_images



Step 2: Finding the Data

4. Using your Internet connection go to http://terraserver-usa.com/

5. When the web page opens locate the search area in the upper left corner of the page.

6. Click the box under City, and key-in **Gettysburg**.
7. In the State box, key-in **PA**.
8. Click the Go button.

After a moment a page showing the search results will open, it should look something like the following.

Place Search

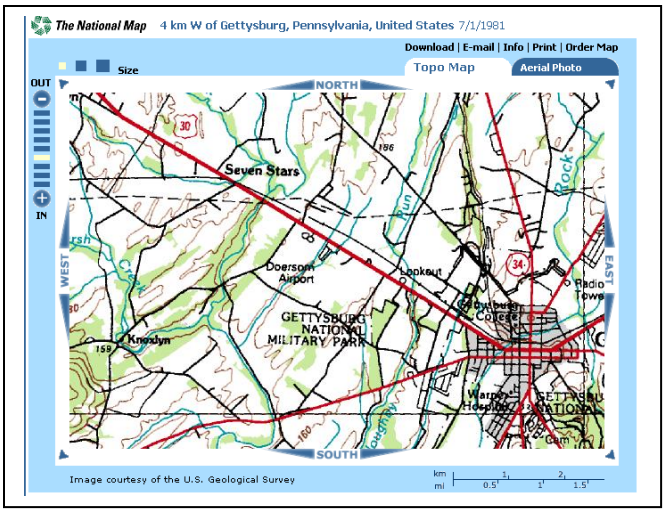
Find Results for 'Gettysburg, PA'

	Place Name	Available Image
1	Gettysburg, Pennsylvania, United States	Aerial Photo 4/18/1994 Topo Map 7/1/1981
2	Gettysburg College, Pennsylvania, United States	Aerial Photo 4/18/1994 Topo Map 7/1/1981
3	Gettysburg Hospital, Pennsylvania, United States	Aerial Photo 4/18/1994 Topo Map 7/1/1981
4	Gettysburg National Military Park, Pennsylvania, United States	Aerial Photo 4/15/1994 Topo Map 7/1/1981
5	Gettysburg National Military Park, Pennsylvania, United States	Aerial Photo 4/15/1994 Topo Map 7/1/1981
6	Gettysburg Visitor Center and Museum, Pennsylvania, United States	Aerial Photo 4/18/1994 Topo Map 7/1/1981

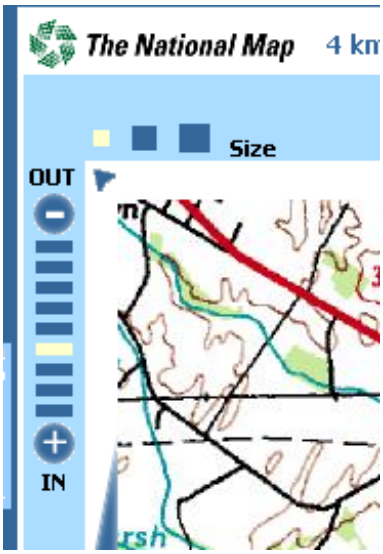
The left column gives the available place names; the right column shows the data available. Move your cursor over the right column, notice that the image titles are “hot”.

9. Click on a Gettysburg National Military Park Topo Map. (Topo Map 7/1/1981)

A map viewer will open showing the USGS topographic map of the area of the Gettysburg National Military Park.



10. Make a note of the position of the zoom scale to the left of the image.



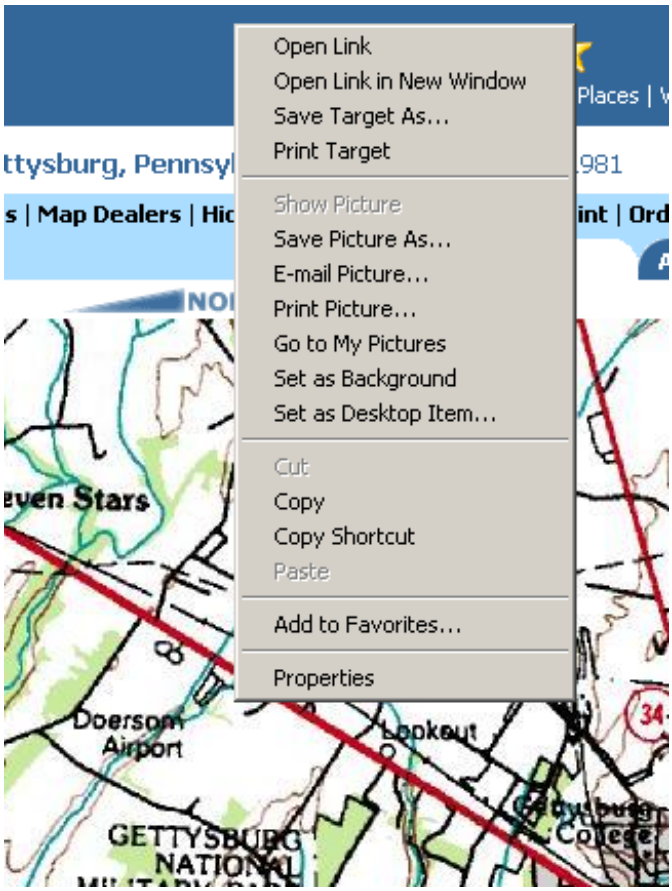
The zoom scale allows you to move into the map (+) or away from the map (-). Zooming is like moving the map closer to you (+) or away from you (-). Since you are looking at a part of a larger map, zooming allows you to select the area you are looking at and will eventually download.

11. In the upper right corner of the map viewer you will find a line that gives you the following options: Download | Email | Info | Print | Order Map.

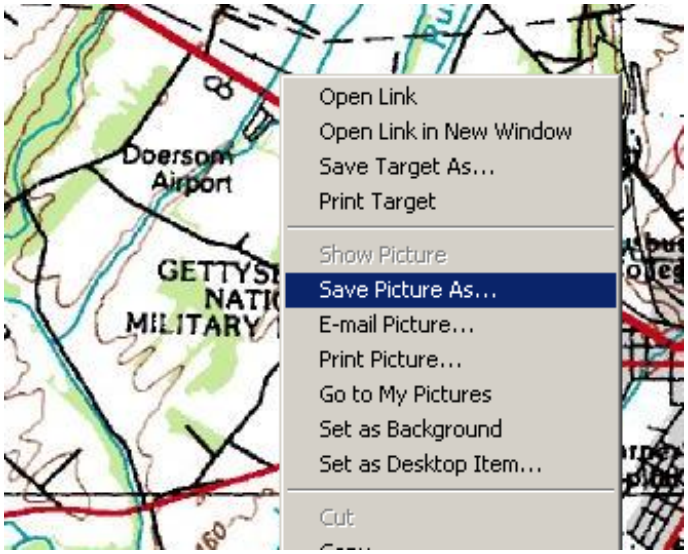
12. We are developing a GIS so we need to work with “Digital Data”. Two of the headings above concern us, **Download** and **Info**.

Step 3: Saving the Data

13. Click on the “Download” link on the map view.
14. The system will work for a moment and change to a download page. If you scroll down the page you will find further instructions. (the following steps go through them)
15. Move your cursor over the image, stop at about the center. Right click your mouse. A fly out similar to the one below will appear.



16. Select **Save Picture As**

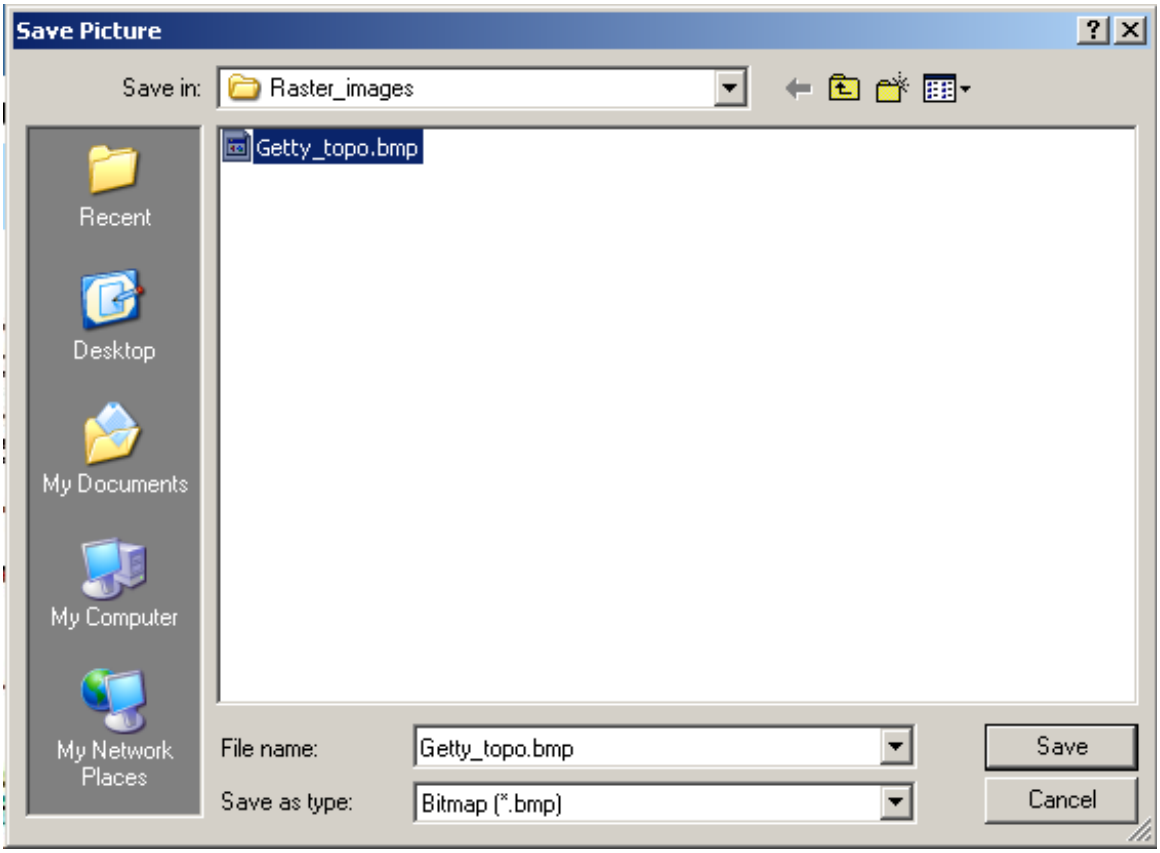


17. In the Save As dialog box that opens browse to the Raster_images folder created earlier.

18. For a filename enter: **Getty_topo**

19. Make sure the filetype is **.bmp**.

This example uses a bmp file extension. Depending upon the GIS software you are using you may want to select the jpeg or .jpg image type.

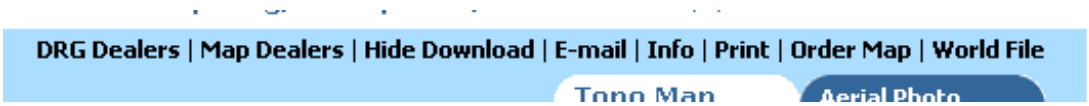


20. Click **Save**

21. Creating a World File

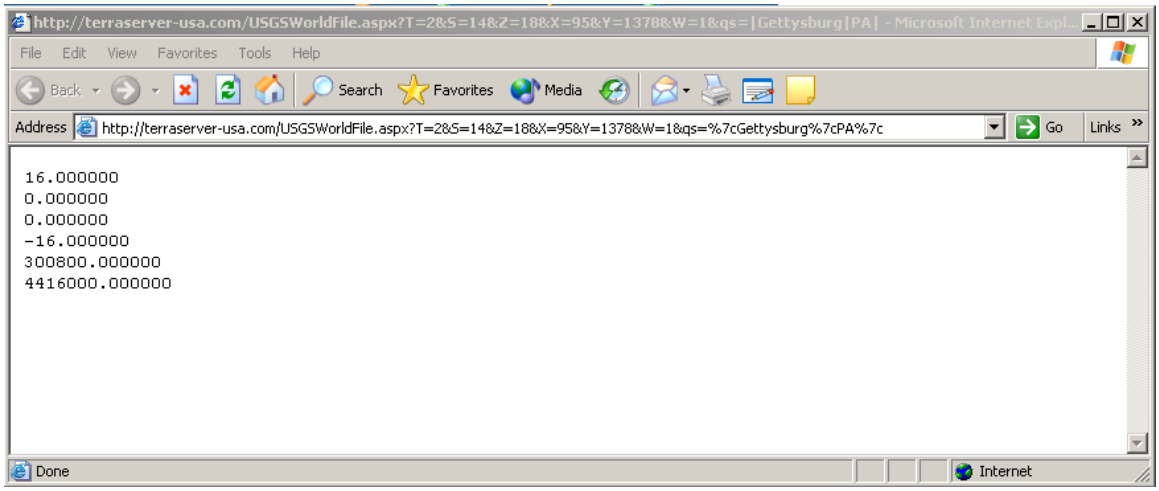
> A World File is a file that expresses the coordinates of the digital data you are using. A world file **must have the same file name as the raster image and it must be in the same folder.** A world file is created by eliminating the middle letter of the three letter extension and adding a 'w' to the end of the extension. A bmp world file becomes bpw, a jpg world file becomes jgw etc.

At the top of the download page we have been using, the selections have changed to:



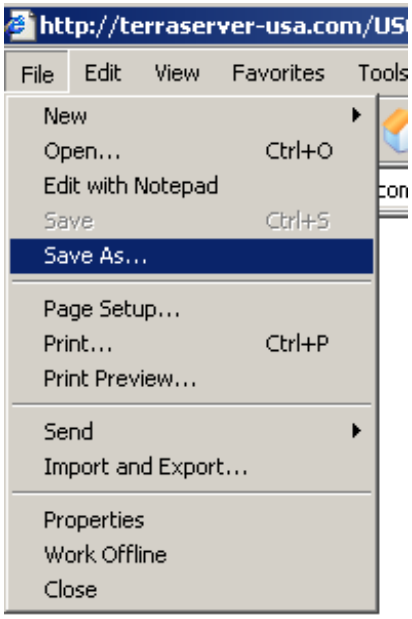
Click on **World File**.

A new browser window will open…..



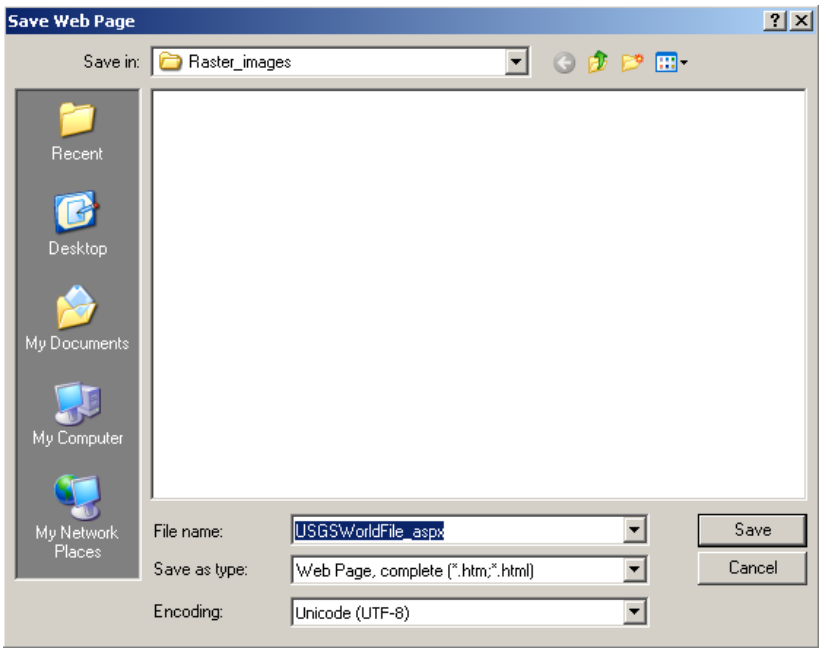
This simple six-line text file is a very powerful part of a GIS working with raster images. It has the ability to align the image with other data from the world. It allows us to place the layer created from the data on the earth in the proper place.

Click File from the top menu bar….



Click **Save As…**

A **Save Web Page** dialog box will open.



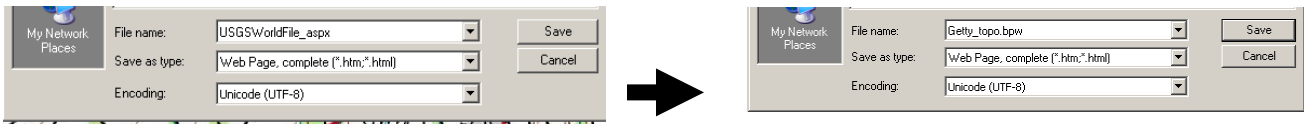
In the file name box name the file the same as you named the pervious file.

Getty_topo

Give the file a .bpw extension.

Getty_topo.bpw

Use the scroll arrow in the **Save as type:** box to select Text File (*.txt)

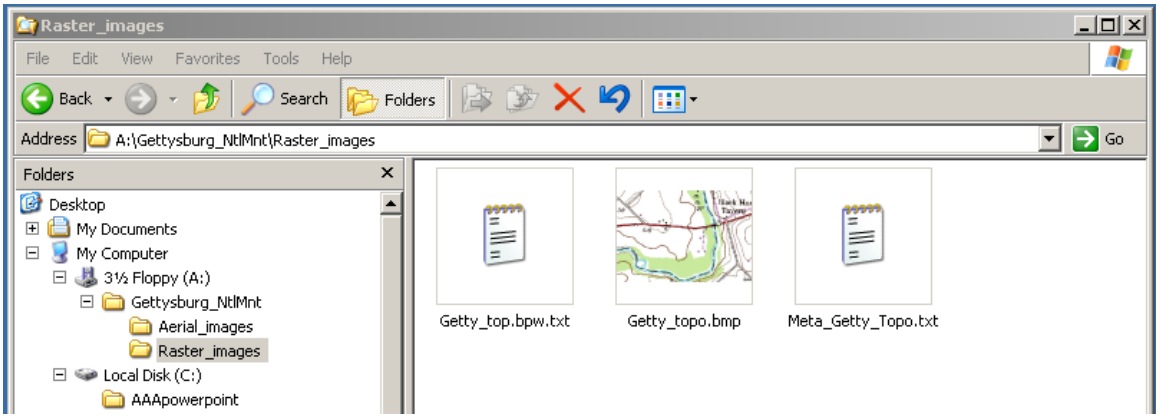


Click Save.

Close the world file browser window.

22. Correcting the world file name….

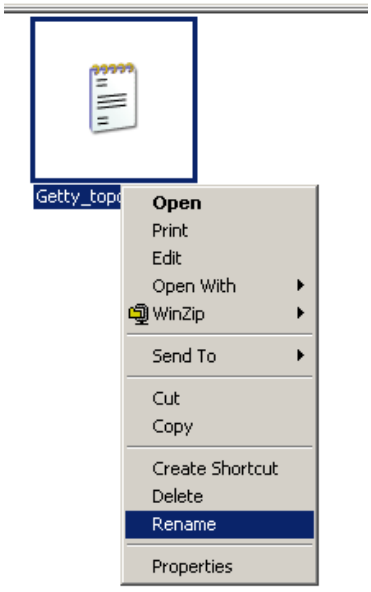
- Use Window's Explorer to browse to the Raster_images folder used to store the downloaded files.



Notice that the world file has a .txt extension

(In the above example the View setting is Thumbnails)

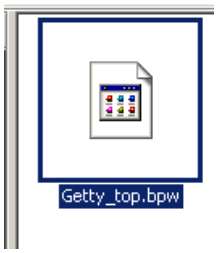
- Right click on the **Getty_topo.bpw.txt** file.



Select **Rename**.

The file name will appear with a box around it with the entire name highlighted.

Left click in the box around the filename. The highlighting will be removed from the file name.



Very carefully remove the .txt from the file name. (use the backspace key)

Click outside of the box around the file name to finish the name change.

A dialog box may open asking you if you really want to change the file name. Confirm by clicking Yes.

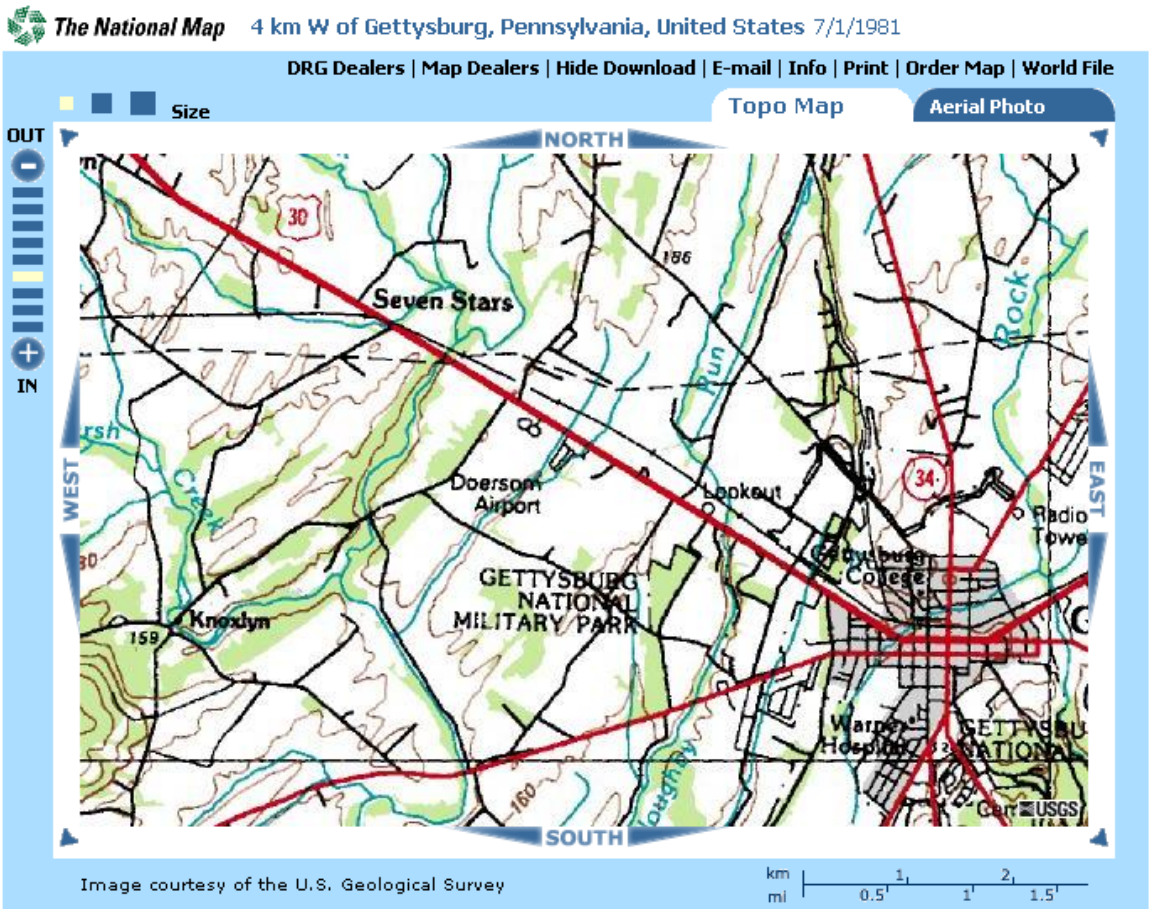
The properly renamed file will look like…..

Step 4: Metadata

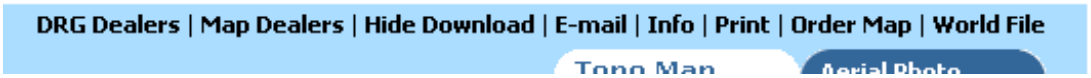
Metadata or data about the data is an essential part of any GIS. The types and sources of data used in a GIS are varied and extensive. Anyone working with GIS data or building datasets needs to create and store metadata. The metadata will tell a new user (or one who has forgotten) the source of the data, the projection system used with the data, the data's accuracy, and the date of the data. Metadata may also contain special information about how and why the data was created.

CREATE AND USE METADATA!

23. Return to the browser window from which the data was downloaded.

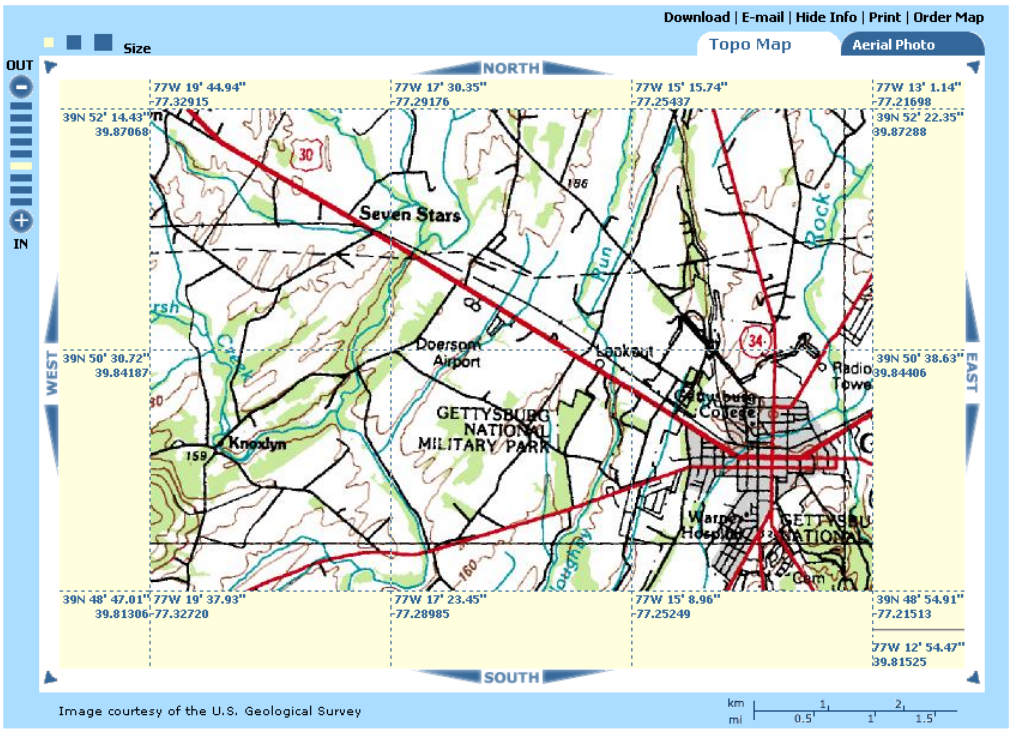


24. At the top locate the **Info** tap.



25. Click **Info.**

26. A new window will open showing some additional information.



Notice that this image has longitude and latitude lines displayed. The lines create a **graticule.** The intersections of the lines are marked with the latitude and longitude in both decimal degrees (DD) and degrees, minutes and seconds (DMS).

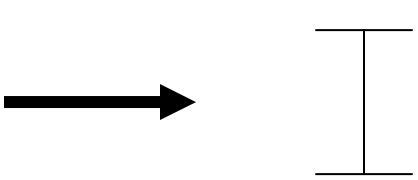
27. Scroll down the page to access the information below the map viewer. A section called “Image Information” appears. This information is the basic information used to create metadata.

Image Information:
Projection: North American Datum 1983 / UTM Zone 18N
Provider: U.S. Geological Survey
Resolution: 16.000 meters per pixel
Size: 600 pixels wide by 400 pixels high
Type: Digital Raster Graphics (scanned topographic maps)

We could copy this information to a paper note, but since we are working with digital data it makes more sense to work with it digitally.

28. Copying the data…

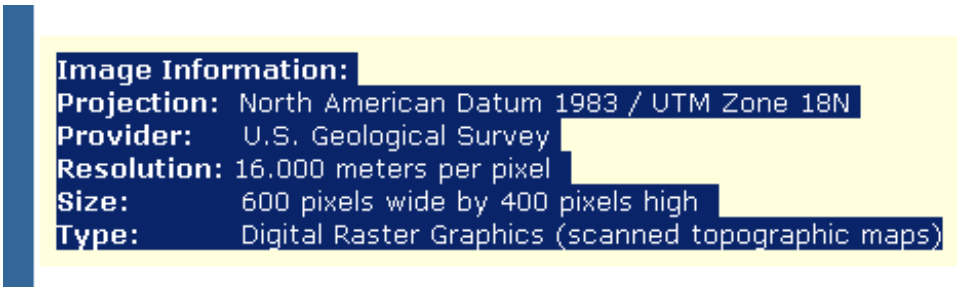
a. Move your mouse cursor over the text until the I beam cursor appears.



Try starting at the **)** after maps at the end of the information

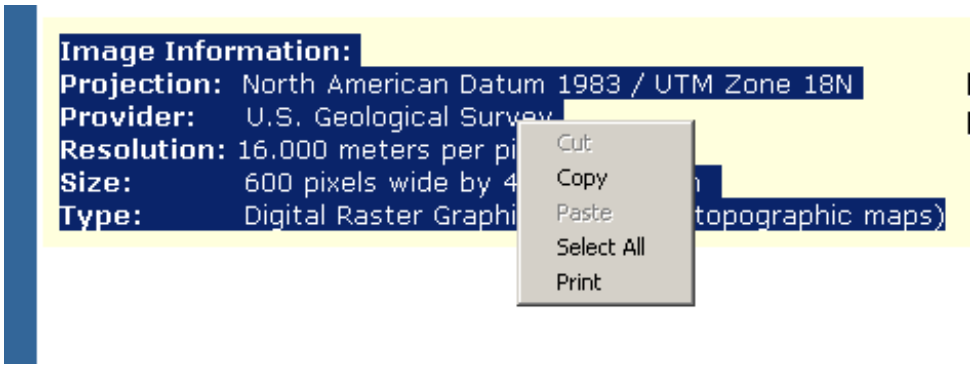
b. When the I beam appears, hold the left mouse key down.

c. Wipe the cursor (holding the key down) over the text to select it all. The selection should look as follows…



Note: Be careful not to select the image above the text!

d. when the text is selected, right click and select Copy. (keep your cursor on the selected text)



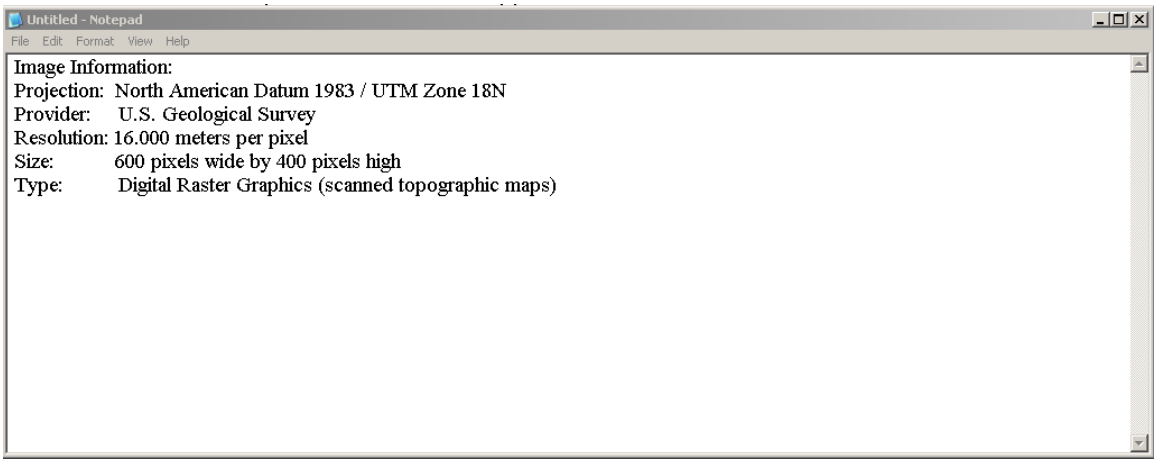
29. Open a text editor – Notepad is on most Windows workstations.

Use: **Start > Program > Accessories > Notepad.**

30. Paste the copied information into Notepad.

    a. Either right click and select Paste, or use the menu items..**Edit>Paste**

31. The copied information will appear in the text editor.



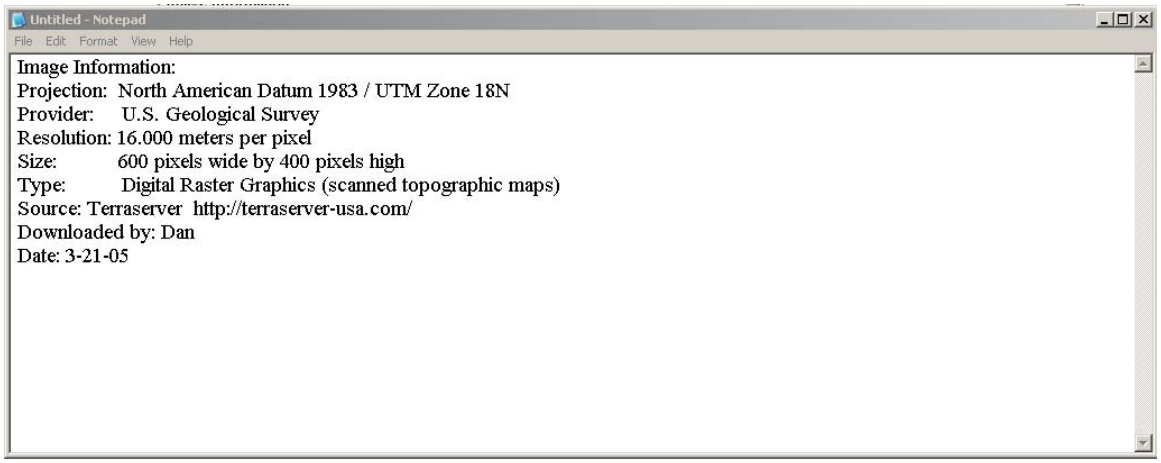
32. Using the text editor add the following lines to the text.

    a. Source: Terraserver http://terraserver-usa.com/

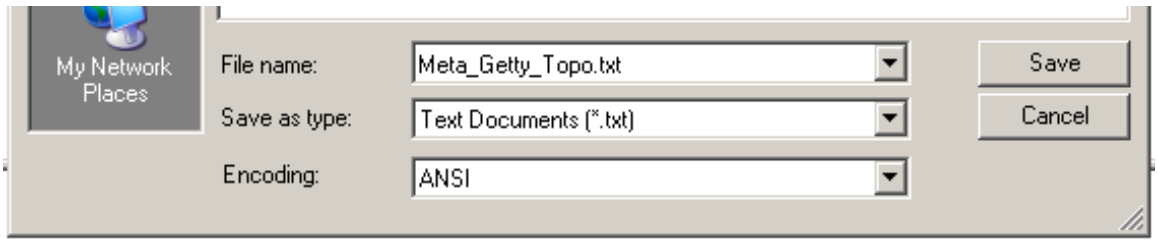
    b. Downloaded by: (put your name here)

    c. Date: (enter the date you created the file)

Your file should look similar to the following….



33. Save the file to your Raster_images folder as: **Meta_Getty_topo.txt**



Note: If you use a different text editor like a word processor make sure to save the file as a text or .txt file.

Why are metadata files saved as text files?
Metadata should always accompany data files. As GIS use becomes more accepted data is often shared between users, departments, engineers, and others. Frequently the data is stored on a server where it can be accessed and used for many different things. Since the data may be used by others, and since many word processors save files in a proprietary format (the software used to save the file is needed to reopen the file) it may be difficult for a new user on another workstation to open and read the metadata. To help overcome this problem metadata is typically saved in a format that almost any computer user will be able to access. Two formats widely accepted and which can be opened on almost any workstation are text (.txt) files and webpages or .html format files. Metadata is commonly saved in one or both of these formats.

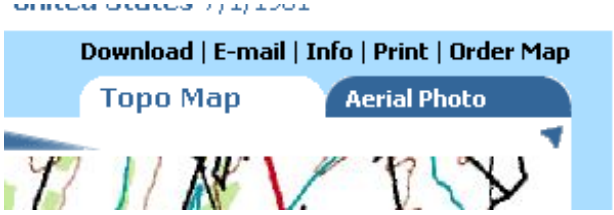
Congratulations! You have created a set of files which can be used in a GIS!

Step 5: Obtaining an Aerial Photo

Use the skills learned in steps 11-33 to download an Aerial Photograph of the Gettysburg National Military Park.

Create an Aerial_image subfolder under your Gettysburg_NtlMnt folder to same the aerial photo file set.

If you still have the browser open to the site, there is an Aerial tab at the top of the map viewer that will give access to the aerial photo of the site.



Clicking on the Aerial Photo tab will display the aerial photo.

To insure that the image is the same size as your topo map make sure the zoom scale is on the same setting. (#10)

Save these files as:

Image file: Getty_aerial.bmp

World file: Getty_aerial.bpw

Metadata: Meta_Getty_aerial.txt

Introduction to Data Collection
Lesson 3 – Adding Data to ArcMap, Downloading and using data from internet
Teacher Instructions

Background

From a clearinghouse, each state will be different, however once you have found the site, step by step instructions are typically included. This document contains provides some useful hints.

1. Getting to the downloadable data
    a. click on any links that say data, resources or downloads
    b. there may be categories of data; find one that says images or roads
        i. these will be the two most useful types of map layers
    c. map/data layers will most likely be presented in a list
    d. Enter clearinghouse
        i. Students will probably have to register. Enter name, information requested, user name and password.
        ii. After your information is confirmed, use your username and password to enter the clearinghouse
    e.

2. Looking for appropriate layers
    a. look for the name of the data layer
        i. this is what you most likely click on to start download
        ii. some clearinghouses will allow you to preview the data layer to make sure it is what you want
    b. choices of GIS formats
        i. For roads (or other vector data), if you have a choice of formats select “Shapefile” (.shp)
        ii. For aerial photos (or other raster data), if you have a choice of formats, select “geotiff”
        iii. For aerial photos, if the format is other than “geotiff”, you may have to ALSO download a “world file” or “header”. Instructions should be on the page

3. Start download
    a. once you have located an appropriate data layer, click on it to start the download
    b. An option to save or open will sometimes be offered – select “save”
    c. A dialog box should then open for you to select the drive and folder to save the data layer to.

4. After downloading, look for “metadata” for each map/data layer
    a. this will include valuable information about the layer
        i. metadata will describe the map/data layer so you can decide if it will be valuable for your use
        ii. LOOK AT THE METADATA FOR SPATIAL REFERENCE – WRITE DOWN THE COORDINATE SYSTEM AND DATUM OF THE LAYER YOU WILL BE USING
            1. This is very important for a later step
            2. Common spatial references are:
                a. GCS – WGS 84 or
                b. UTM Zone 15N NAD84
                c. Numbers may change but format should be similar

5. “Unzipping” the data layer
    a. The downloaded data layer may be in a compressed format
        i. use windows extract utility
            1. find compressed file in my computer
            2. right mouse click on compressed file
            3. select “extract all to this location”
                a. this saves the uncompressed files in the same folder as the compressed file
        ii. a utility such as WinZip may also be used.

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