GEO/EVS 425/525 Unit 6
DEMs, DLGs, DOQQs, DRGs, SDTS files, and Map Reference Systems

This exercise will introduce you to the use of digital data from the United States Geological Survey. USGS produces a large number of Digital Elevation Models (DEMs), Digital Line Graphs (DLGs), Digital OrthoPhoto Quarter Quadrangles (DOQQs), and Digital Raster Graphics (DRGs). The DEMs and DLGs are probably the most important sources of elevation data for the country. You can obtain these products from USGS via CD-ROM, but it is more likely that you will obtain them from the WorldWide Web. USGS is in the process of translating standard DEMs and DLGs to a new format entitled Spatial Data Transfer Standard (SDTS). We shall examine DLGs and DEMs in both the standard formats and the SDTS format. DOQQs are aerial photographs which have been georeferenced to the UTM reference system, typically at a resolution of 1 meter per pixel. DRGs are scanned USGS topographic maps, also georeferenced to the UTM system.

A DEM is an elevation image set forth as a raster. There are several formats. The most common (by far) is the 1:24,000 DEM, in which the bounds of the image are UTM, the pixel size is 30 m, and the units in all three dimensions are meters. Some 1:24,000 DEMs have elevations in feet, but you won't run into any of these in this exercise. These images are equivalent to the standard USGS 1:24,000 quadrangle maps and are available for most fo the country. The second most common is the 1:250,000 scale, in which the bounds of the image are in degrees, the pixel size is 3 arc-seconds, and the units in the X and Y directions are decimal degrees and in the Z direction are meters. A DLG is a denotation of features such as contour lines, roads, railroads, boundaries, etc., set forth as a vector. Again, there are several formats corresponding to the standard USGS map series. A single DLG typically contains one sort of information (i.e. it is roads *or* waterways *or* railroads *or* municipal boundaries, etc. All of the DEMs and DLGs you will use in this exercise are in the 1:24,000 series. DEMs and DLGs are in a format that neither Imagine nor any other remote-sensing program can read directly; hence they must be *imported* into the standard vector (for DLGs) or raster (for DEMs) format used by Imagine. DOQQs and DRGs are images that are usable as you download them.

To import DEMs and DLGs, you use the "Import" utility from the main Imagine Control Panel. Basically, you click on the Import button on the Control Panel and choose "USGS DEM" or "DLG" as the Type and "File" as the Media. You will download the files you want to import onto your X: drive from the WorldWide Web. You will supply a suitable name for the output file and click OK. In all cases, you should use the default settings in the "Import" dialog *except* that you should ignore zeros in output stats if asked. Imagine will then extract all of the information in the file into the appropriate Image or Arc Coverage file.

Choosing a Suitable Quadrangle

Your first job in this exercise will be to choose a quadrangle from somewhere in northeast Ohio. You will work with imagery and files pertaining to this quadrangle for much of the rest of the semester. The only criterion is that it needs [1] to be in Ohio, [2] to be covered by one of the satellite images we have on file, and [3] to be close enough that you can field-check some of the results you obtain later in the semester. Most of the quadrangles in the immediate Cleveland area are suitable; if you have a question about a quadrangle of particular interest to you, ask me. ***Be sure and choose a quadrangle of interest to you, because you will use this quadrangle for many of the remaining exercises in this course.***

DLGs Obtained from the WorldWide Web

The first files you will obtain from the WorldWide Web are the DLGs for the quadrangle of your choice. These DLGs have been prepared by the State of Ohio from 1:24,000 USGS topographic maps. The names for the quadrangles is of the form cl128ohp.zip, where the "cl" refers to the location of the files (in this case it's the "Cleveland_North" directory), the "128" is the actual map (In this case "cl128" is the actual Cleveland North quadrangle, the "o" refers to the format of DLG being provided (in this case it's

the “optional” format, as opposed to the “standard” format, which has become less common than the optional), the “hp” refers to the type of DLG (in this case, it’s the hypsography DLG), and the “.zip” indicates that the file has been zipped. You will need to find the number for the quadrangle you have chosen. The index for quadrangles is posted in the laboratory.

Each quadrangle in this series is represented by 7 DLGs, with the following 2-letter abbreviation: Boundaries [bd], Hypsography (elevation)[hp], Hydrography [hy], Miscellaneous Transportation Features [mt], Public Land Survey [pl], Roads [rd], and Railroads [rr]. You can find the link to the mapping information in Ohio from the department web page: **http://www.bges.csuohio.edu/links**. The actual URL for the state maps, if you want to type it in for yourself, is **http://www.state.oh.us/das/dcs/gis/.**

The easiest way to get files from this site is using the program FTP Commander on the computers in the lab. When this program comes up, it will present you with a profile for both your local computer and a series of available FTP servers. You should first make the correct settings for your local computer. Make sure that your local directory (in the window on the left-hand side of the profile) is **x:**. If you want to place files in a special place, you can choose a particular subdirectory of X:, but your basic directory must be X:. You will see that the structure of your X: drive will appear when you set X: as your local directory. Now set your FTP server to Ohio DAS on the right side of the profile.

When you have connected to the Ohio DAS site, you will be shown the structure of the site. Navigate to the folder in which your quadrangle is found (first “geodata”, then file type, and so on) by double-clicking on the folder name. When you find the files you want, copy them onto your X drive: Highlight the name by clicking on it; then click on the button showing the left-pointing arrow between the two windows. Note that you can copy several files at once by highlighting several names at once (using control-click) and then clicking on the left-arrow button.

When you have arrived at the folder containing the DLG files for your chosen quadrangle, download all 7 DLGs from the quadrangle. The files you obtained will be compressed using “zip” technology. On most machines, you need to unzip them before you can use them. The machines in the Remote Sensing laboratory contain a program called “ZipMagic” which translates zipped programs automatically and will let you import them directly into Imagine without having to unzip them.

Now import the DLGs into Imagine. Again, you do this by clicking on the “Import” button on the main Imagine Control Panel. Then choose “DLG” as your import type and “file” as your media. You can examine the data in the dataset by clicking on the “Data View” button. You should do this for at least one DLG. Does the structure of the data make sense?

1. Extract *all* of the files for that quadrangle. What information is contained in each file?

2. Examine each file. Which are line files? Polygon files? Point files? Develop appropriate symbology (i.e. colors, line widths, symbols, etc.) for the most significant items in each file. Save each symbology

3. Put the DLGs into a single viewer. How closely does it approximate the information given in a USGS topographic map?

DEMs obtained from the WorldWide Web

You should now get the DEM for your quadrangle in the same way, using FTP Commander. Navigate up out of the DLG directory and down into the DEM directory. The structure of the DEM directory is identical to that of the DLG directory. Copy the appropriate zip file to your X: drive and import it as a raster image. The import operation is identical to the import of a DLG except that the file type is DEM (USGS) rather than DLG.

When you have finished importing your DEM, put it in the same viewer as the DLGs of your quadrangle.

Adjust the images so that you can see all of them. How closely does it approximate the information given in a USGS topographic map? **This composite image should be included in your portfolio for this unit.**

DOQQs and DRGs obtained from the WorldWide Web

Now get the DRG and the four DOQQs for your quadrangle. Again, navigate from the DEM directory to the DOQQ and DRG directories as you did going from the DLG directory to the DEM directory. Note that each DRG consists of one zip file, which you should download. On the other hand, DOQQs have several options, of which you will want to download *two* files for each quarter-quadrangle. First, you need to find the files you want. The files have names like cl315ne0017.sid. Much of this is what you already expect. The "cl315" is the same quadrangle identifier as for DLGs, DEMs, and DRGs. The next piece (ne, nw, se, and sw) refers to the quarter-quadrangle in question; you will need four to make up a full quadrangle. The next part of the name is a number. You will only need the files identified as "0017" (the designation "0017" refers to UTM Zone 17; the other two designations refer to two different State Plane designators) You will need *both* the sid and sdw files for your quarter-quadrangles. We can discuss what these are in class.

DRGs and DOQQs are in GeoTIFF and MrSid formats, respectively. These can be read directly into your viewer, except that you will have to change the file type from "imagine image" to the appropriate type in order for the viewer to find the file in question.

SDTS Files Obtained from the WorldWide Web

An increasingly common form for digital map data is the Spatial Data Transfer Standard (SDTS). Digital imagery in SDTS format is available from the US Geological Survey from their web site. If you want data from outside of Ohio, you will likely get it from the USGS site, and it will be in SDTS format. You can access the USGS data source from the departmental web site, **http://www.bges.csuohio.edu**. The actual URL for the USGS site is http://edc.usgs.gov/geodata. Go to this page and click on 1:24K DLG or 1:24K DEM. Find your quadrangle of interest (you will have to navigate down through "FTP by State" to "Ohio" to the name of your quadrangle, and download the DEM and at least one DLG onto your X: drive. Note that it has a very long name, and that it is in "tar.gz" format. "Tar-gz" is a Unix compression and grouping format, and you have to decompress and expand the file in order to do it. Again, you will use ZipMagic to do this, but it isn't automatic. In fact, it's a two-step process.

Open ZipMagic by clicking on the icon. Click on "open" and then change the file type to "all archives." Open the tar.gz file you downloaded. Click on "extract," and ZipMagic will decompress the file and create the corresponding "tar" file. Note that with some files, you may need to add the ".tar" extension so that it can be found correctly by ZipMagic. Now click again on "open", and click on the tar file you just decompressed. Click again on "extract," and the DDF files making up the SDTS file will be generated. There are a lot of these DDF files in each SDTS quadrangle.

To import the SDTS files into ERDAS Imagine, click on "Import" on the Imagine Control Panel, and chose "SDTS Raster" as the type for a DEM or "SDTS" as the type for a DLG. The media is "file," and the file to choose is the DDF file with a label something like xxxIDEN.DDF, where xxxx is a number. Click on OK, and Imagine will extract the file.

Load your imported DEM and DLG into a viewer. **This composite image should be included in your portfolio for this unit.**

Map Reference Systems

We need to consider map reference systems when dealing with DEMs and DLGs. These digital maps are available in several different projection reference systems around the world. In the United States,

two reference systems are currently in use: the North American Datum for 1927 and the North American Datum for 1983. Worldwide, several other systems are in widespread use, of which the one you are most likely to encounter is WGS84, which is essentially the same as NAD 83. Several different spheroids are also in use, although the most common is the Clarke, 1866 model of the earth. If you wish to overlay images derived from DEMs and DLGs (or any other source, for that matter), it is important that they be referenced to the same system. It is important that you know how to change reference systems.

Let's change the reference system for one of the quadrangles you've dealt with in this exercise. First, use VectorInfo to determine the same reference system your images are in. What is the reference system? The "georeference" listing in VectorInfo refers to the basic reference system; the "spheroid" listing refers to the reference spheroid; the "datum" listing refers to the datum of the reference system. The "zone" listing gives the UTM or State Plane zone. Most of our DEMs and DLGs are, as are most such products, in the UTM system, using the Clarke 1866 spheroid and the North American Datum of 1927. This is the standard used by USGS for their paper maps. Now let's change the DEM to the State Plane projection. Run the reprojection module by clicking on Interpreter-Utilities-Reproject. Insert the name you provided the Image file when you imported the DEM. Note that you can only Reproject Image files; you cannot use this module to reproject Arc Coverages. Choose to reproject the image to category "US State Plane – NAD 83". The State Plane zone for all of northeast Ohio is Ohio-North. State plane units are in feet. When you're calculating the size of the output cell, try to keep the number of rows and columns about the same as in your original, but remember that you have to convert 30 meters to feet! (1 foot = 0.3048 meters). Use Nearest Neighbor as the resample method. When the reprojection is done, do you see a difference? Why do you think that the change has occurred?

Now let's change the projection of one of the DLG images to match the DEM. Load a DLG-derived image into the viewer, and use VectorInfo to determine the reference system. Click on Edit-Reproject the Coverage from the VectorInfo menu bar. Choose the "Standard" tab of the dialog that opens, and choose "US State Plane – NAD 83" as the projection. Choose Ohio-North as the zone and then click on OK. The coverage will be reprojected.

Finally, load the DEM you have just reprojected into a viewer, and load the DLG you've reprojected on top of it. **This image should be included in your portfolio for this unit.**

Questions to Consider

1. Is it possible to create a DEM with a raster size of 25 meters rather than 30 meters? If so, how do you think you might do it?

2. What things might you want to include in an image that you were not able to get from DEMs and DLGs?

Portfolio

1. Your composite image with the DEM and DLGs for your quadrangle, as downloaded from the Department of Administrative Services site, with each DLG having a suitable symbology.

2. Your composite image with the DEM and a DLG downloaded from the USGS web site in SDTS format, with your DLG(s) having a suitable symbology.

3. The composite image of the same DEM as in the previous instance with at least one DLG superimposed over it, both (all) having been reprojected to the State Plane reference system.