**GEPL 4490/5490 Lab #1** **9/8/04**
**Working with Single Photographs**

**Due: 9/27/04**

Whenever we work with maps, photographs, and images, we are working with materials that are representations of the earth's surface. In this lab, we will review skills of map reading, since often times we combine information from map resources that can provide us with reference for our remotely sensed data.

The first part of this exercise will help familiarize you with the information content of topographic maps. Many of you may be very familiar with topographic maps, but this will be a good review. For this lab we will focus on an area familiar to us or at least will become familiar to you if you are not from this area, Toledo, OH.

For the following questions use the Toledo Quadrangle:

1) What is the scale of the map and which year was it produced?

2) Find northwest corner of the Cherry Street bridge on the map and determine its location in latitude and longitude. You will need to interpolate between latitude and longitude tick marks.

For latitude, start with the lower right hand corner of the map where the latitude is 41° 37' 30" where ' is minutes and " is seconds. The next tick mark up the right hand side of the map is labeled 40. The latitude is 41° 40' 00" so the difference between the two tick marks is 2' 30" or 150". You can measure the distance between the tick marks in tenths of mm and figure out the number of mm per second of latitude. Then, measure the distance from the 41° 37' 30" tick mark to the northwest corner of the Cherry Street bridge. Finally, plug the numbers into the equation below to find the number of seconds in latitude that the bridge corner is from 41° 37' 30".

Using the equation $\frac{lat}{dist} = \frac{total\sec onds}{totaldis\tan ce} = \frac{150}{totaldis\tan ce}$ to calculate the number of seconds, add the seconds to 41° 37' 30".

Do the same for longitude where the corner of the map has a longitude of 83° 30' 00".

3) What is the contour interval of the map?

**Issues of Scale:**

Scale is the ratio of distance on a map (or image) to the equivalent distance on the ground. It is communicated as a representative fraction (RF), such as 1/20,000 or 1:20,000. Remember that the units of the numerator and the denominator of this fraction are the same, e.g., 1 cm on the map: 20,000 cm on the ground.

**A large scale map shows a small area of the earth's surface. A small scale map shows a large area of the earth's surface.**

Determining ground distance: If you know the representative fraction of the map you are working with, you can easily calculate ground distance.

Example: If you measure the length of a straight road segment as 3 cm on a topographic map which has a scale of 1:24,000, how long is that road segment in actual ground distance?

$$\frac{1}{24{,}000} = \frac{3}{x}$$

X=72,000 cm (then convert to requested ground units, e.g. meters, feet, miles)

4) What is the width of the Maumee River at the Cherry Street bridge?

**Vertical and Oblique Photographs**

Aerial Photographs represent one form of remotely sensed data. They record reflected energy in optical (solar wavelengths), with potential film sensitivity ranging from 0.3-0.9 µm (uv-visible-near infrared wavelengths).

Photogrammetry is the science and art of making reliable measurements from photographs. This is one approach to the analysis of aerial photographs. Air photos are usually referred to as being vertical or oblique. Vertical photographs are produced when the camera's optical axis is oriented vertically to the ground surface (approximately 90º). Oblique photographs are photographs where the camera axis is intentionally tilted at a set angle, usually greater than 20º. There are two forms of oblique photos, low and high oblique. Low oblique are tilted photos that only display the surface. High oblique photos will show the horizon, a portion of the sky, and the ground surface.

**Scale of the remotely sensed image.**

Sometimes you will be in situations where you do not know the scale of the remotely sensed imagery you are working with. If you have access to a topographic map, you can determine scale by comparison:

Measure a visually distinct entity that occurs on both the map and the photograph (e.g. a segment of straight road, from one intersection to the next). Using the topographic map, you can determine the actual ground distance of the measured entity as above. For example, above, 3 cm on the map was the same as 72,000 cm on the ground. On a photograph, that same distance measures 6 cm. To find the scale of the photograph.

$$S = \frac{1}{x} = \frac{6}{72{,}000} = \frac{\text{Distance on photo}}{\text{Distance on ground}}$$

Representative fraction is 1:12,000

Or, the scale can be found as a ratio of the focal length (*f*) of the camera and the height (*H'*) above the ground the photo was taken from.

$$S = \frac{f}{H'}$$

For the following questions, use the Toledo air photo and the Toledo toposheet.

5) What is the scale of the airphotos? You may need to make several measurements and take the average to get an accurate estimate of scale. What did you measure to determine it?

6) Sometimes a topographic map is not handy when we are working with airphotos, and we'd like to try to determine the scale. Sometimes there are features in a landscape which are a definite ground distance….e.g. 90' between the bases on a men's baseball field. Find something on the photos that has a know length (for example a baseball diamond or football field). Calculate the scale of the photo given the known distance. What was the object you used? How do your two estimates of scale compare? What is the potential disadvantage of using this approach?

Use the oblique airphoto (poster) of Traverse City, MI for the following.

7) Oblique photos are rarely used for making measurements because of distortions caused by the angle of the photography (e.g. distances are not consistent throughout the image). Measure the width between two roads in the foreground of the photo and near the back of the photo. Be sure to use the same two roads. What do your measurements suggest about our ability to make meaningful measurements from vertical versus oblique photos?

**Relief Displacement**

When a camera "looks" directly over an elevated feature, displacement is not seen – the camera has a truly vertical view of the feature – it sees only the feature's top. But, on the same photo, an elevated feature located at the edge of the photo frame would be seen differently by the camera's eye. The camera would look up the side of the feature as well as see the top of the feature. Thus, this feature will appear to lean radially away from the photo's optical center (PP). Relief displacement is thus caused by how the camera lens, when pointed straight down towards the earth's surface, views the world. Relief displacement occurs on single photographs, and is measured with reference to the principal point of the photo. The formula for determining the heights of objects is:

$$h = \frac{d}{r} H'$$

Where

h=height of the object
d=length of the displaced object (from bottom to top of the object).
r=radial distance from nadir to the top of the displaced image.
H'=aircraft height above the base of the object.

**Instructions for accessing data from Geography and Planning's RAID.**

Right click on My Computer and choose Map Network Drive.
Type in \\gisag99.uhw.utoledo.edu\utview
Click okay.
Enter the username: gisag and password gisag
Go to DrCrms_class → GEPL 4490 2003
You do not need to copy this file onto your computer. You can use it off of the RAID.

Use the Toledogeo.img image.

8) What is the date of the Toledogeo.img image? Open Erdas 8.6. Drag and drop Toledogeo.img into the viewer.

9) Zoom in until you see the pixels. What is the pixel diameter (resolution) (in meters) of Toledogeo.img? Use the measurement tool from the viewer menu bar.

10) Measure the width of the Maumee River at the Cherry Street bridge using the measurement too? How does it compare to your other measurement?

11) When we work with air photos, fiducial marks help to define the optical center of the photograph. The optical center is known as the Principal Point. Open Toledogeo.img. Find the principal point of this photograph. Use the inquiry cursor (Plus sign) and locate the center of the image. Then, use maps from Topozone.com to find the latitude and longitude of the center of the photo. http://www.topozone.com

12) Notice how you can see both the top of buildings and their sides. What is the height of the tall building at the corner of Cherry and Summit Streets? The aircraft for National Aerial Photography Program (**NAPP**) flies at 20,000 feet above sea level.

Use the mosaic airphoto L8_Color_50x.sid (a Mr. Sid file with no georeferencing information) from the Lucas County Auditor's Office and the topographic map of the area from 1938.

Go to back out of DrCrms_class and go to RemoteSensing → Photographs → AerialPhotos

13) At approximately what time of year was this image taken?

14) What are some of the major temporal changes that you see when you compare this photo to the topographic map?

15) What is located at X: 1664532 by Y: 750696. Use the inquiry cursor to find it. Type the values for X and Y in and the inquiry cursor will go to that location. When trying to identify the objects, make the two lists that we talked about in class.

16) What is the dark 2 inch circle with the bright four leaf clover in the center to the west of the waste water treatment plant at X: 1698695 and Y: 739352? Use the two list method again.