Mapping Your School & Learning About Resolution

Purpose: To help students learn to think spatially by mapping a familiar area. To introduce students to the concept of resolution, an important concept in interpreting satellite images of earth.

Overview: Students will make a map of school grounds and use two different grid overlays to make a "digital image" of their maps. The two different size grids will illustrate the differences in resolution that are obtained from the same map

Materials Needed:

<u>OUTSIDE</u>: Navigational compass, clipboard (clear plastic bag if it's raining to cover clipboard), regular pencil

<u>INSIDE:</u> Color Pencils, rulers, plain paper, 2 paper grids (one of each size), 2 transparent grids (one of each size), USGS 7.5' Quadrangle map that includes the town, aerial photo coverage map.

Part One

1. Have students divide the school grounds into four quadrants:
   (If your school has very large grounds define a border inside of the school ground as the edge of the quadrants so as not to spend too much time making the map).

2. Teams of students will be responsible for making a map of one quadrant (Things to include: school outline, doors, windows, trees, hedges, cars, school, parking lot, side walk, fire hydrants, mailboxes, etc…)

3. Have the teams take a pencil and clipboard outside and make a map of their quadrant with North at the top of the paper. Remind students to include a compass rose, and a key on their map. Before everyone leaves, use the navigational compass to determine which direction is north.

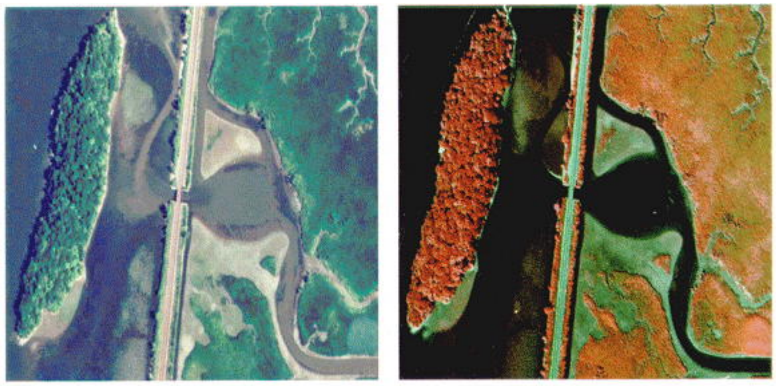
4. When all teams are finished with their map, bring them inside and have them compare the maps they made. What are the differences? (some examples will be a difference in scale, the amount of detail, the accuracy of each map)

Part Two

1. Regroup the teams and have students place the large, grid transparency over their map.
2. When everyone has their large transparency on top talk about classification of land cover (ex. Building, parking lot, trees, shrubs, grass, sidewalk, other important point features). {see classification explanation below}
3. One student in the team is in charge of listing row by row each individual cell (with transparency labeled A-Z 1-50) and assigning it a classification color, another student is in charge of coloring in the appropriate cell with the correct classified color on the grid paper that matches the transparency.
4. Repeat with the smaller grid cell transparency and have a different pair from the same team make the new map.
5. Briefly talk about the differences between the large grid cells/small grid cells. {see explanation below}
6. Show USGS Topo Map of town as an example of a well made map as another way of representing the area.
7. Show the aerial photos taken over the school and town, yet another way of representing the school grounds/town.
8. Discuss scale for all (student maps, USGS, Aerial photo).

Classification Explanation:

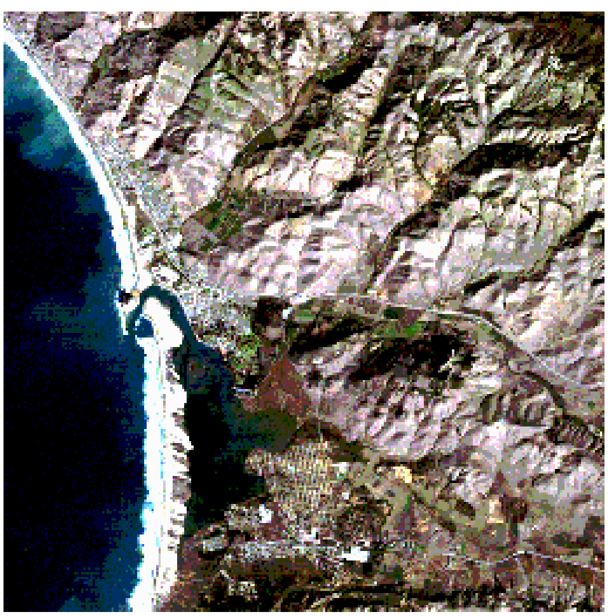
A raw satellite image is a digital file which contains a series of grid cells that have a corresponding digital number. A computer program is then used to view the digital image and the user (or by default, the program) selects a color scheme to display the image. Depending on what wavelength of energy the sensor is designed to collect, the images of the same area may look totally different. A sensor that collects wavelengths of visible light will produce images that will look similar to a color photograph. A sensor that collects wavelengths in the Near Infrared (often called NIR) spectrum will show plants and vegetation as bright features because plants reflect a high amount of light in the NIR spectrum.

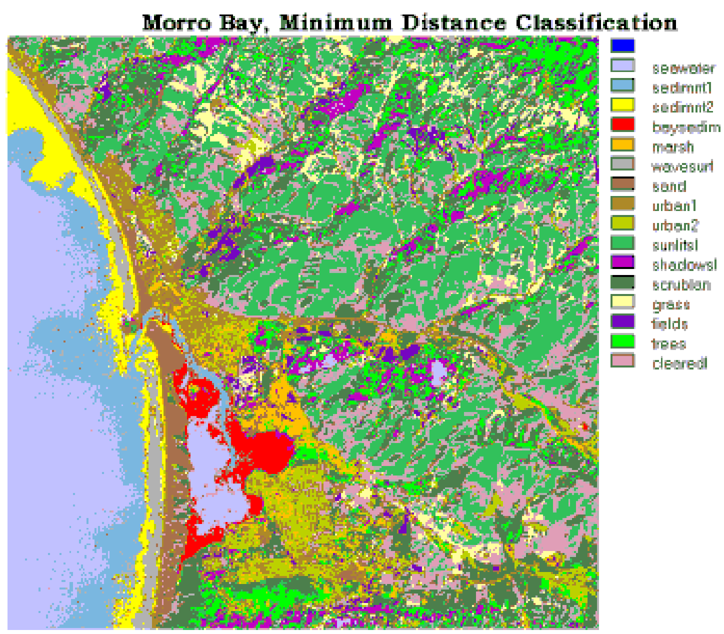


a. b.

The picture on the left is a true color image. The one on the right is a near infrared (NIR) photo. Vegetation reflects a high amount of NIR light, thus the film that is sensitive to this wavelength of light shows bright red where the vegetation is healthy.

In order to better make scientific observations from satellite images the images are classified according to their grid cell value. Since each object absorbs, reflects, and emits energy differently it is then possible to classify an image using known reflectance differences. An example of a classification might be a NIR image of a forest that is near an urban area. The different plant species would reflect differently as would the urban roads and streets. In this scenario logical group categories might include: Douglas fir, Maple, Alder, shrubs, grasslands, urban. An image of this nature might then help foresters analyze total area of Douglas fir trees, and if a series of images from different years were available, change over time could be calculated given the classifications used the same values for categorization.





The image to the left is Band 1, 2 and 3 of Thematic Mapper (TM), which shows an image of Morro Bay California in close to true color. On the right is a view of the same area that has been classified from all 7 bands of TM in to categories useful for a geographic analysis.

Concepts for Discussion

What are the differences between the small grid cell and large grid cells coverage?

A smaller grid size results in images that have more detail, however it takes longer to collect, process and store these files because with more detail the amount of pixel values that one image contains increases significantly.

A larger grid size results in smaller images which can be collected much faster and do not take as much processing or storage, however they have much lower resolution than an image with a smaller grid size.

What is the appropriate resolution for your study?

For example: An urban planner would require images with a high level of detail because small differences in property lines and potential actions/hazards/development from one property can affect adjacent property owners.

Another example: In the ocean, conditions are constantly changing; a high resolution image of an area would only be valid for a brief snapshot in time. Researchers may be interested in a particular phenomena but capturing such fine scale interactions multiple times would be very difficult to capture and analyze due to the dynamic nature of the ocean. Ocean researchers are more interested in learning about large scale ocean processes. Over an expanse such as an ocean where conditions are constantly changing lower resolutions are sufficient for large scale research.

Mixed pixel problem, when there are two different types of land cover in one cell which one wins?

In the exercise students lay a grid on top of the image and classify it according to a few classes. When two different features both occupy the same grid cell a decision must be made as to which feature "wins" the cell. By default most programs assign the feature that has the largest percentage as the value of that cell. The resulting pixel is often referred to as a "mixel" because although in digital form it represents only one value in the real world the pixel represents a mix of two or more features.

A good example would be where a coast line defines the difference between land and water. Where the water takes over more of the cell small areas of beach will be classified as water, and vice versa in areas of sand/rock that take up more than 50% of the cell.

What would happen if we took the large grid image and tried to make an accurate measurement from it to use on a smaller scale?

Due the mixed pixel problem, an image that was made with a very large pixel resolution (for example one image pixel = 1km x 1km on the ground) should not be used to investigate an area that is significantly smaller than the resolution of the image. For example trying to delineate where a river bends using an image with a low resolution to determine property boundaries would not be very accurate because these are relatively small features.