Tracking Change Over Time: Urban Area Change—Phoenix, AZ

Background

These three Landsat 5 images lie entirely within south-central Arizona and encompass the city of Phoenix, its suburbs, and surrounding desert. The city and its suburbs are growing rapidly, both in terms of population and area, so considerable change can be seen in only a few decades.

Population of Greater Phoenix

Year	Population
2009	4,023,331
2000	3,072,149
1990	2,122,101
1980	1,509,175

MultiSpec application: crop all images to the exact same area

The purpose of this lesson is to detect change over time in a particular place using satellite images. To do this accurately, you first need to crop the images so the areas you are comparing are all the same size. MultiSpec can automatically do this.

1. First, open all three Landsat images of Phoenix using MultiSpec (Phoenix1991.tif, Phoenix2000.tif, and Phoenix2010.tif).
2. In the Window menu, select "Show Coordinate View."

3. In the dropdown menu at the upper left, change the units to "Lat-Long (Decimal)."
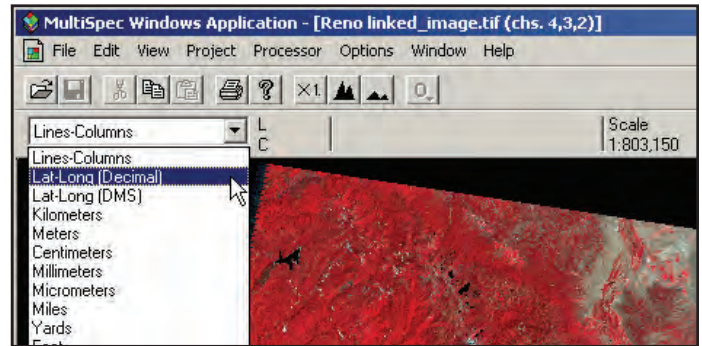
4. In one of the images, select an area beginning with lat-long 33.5605, -112.4069 and ending with 33.2262, -111.6350 (about 3 million pixels; it doesn't have to be too exact). Click and hold while dragging the mouse to choose a rectangular area.
5. In the Edit menu, choose "Edit Selection Rectangle."
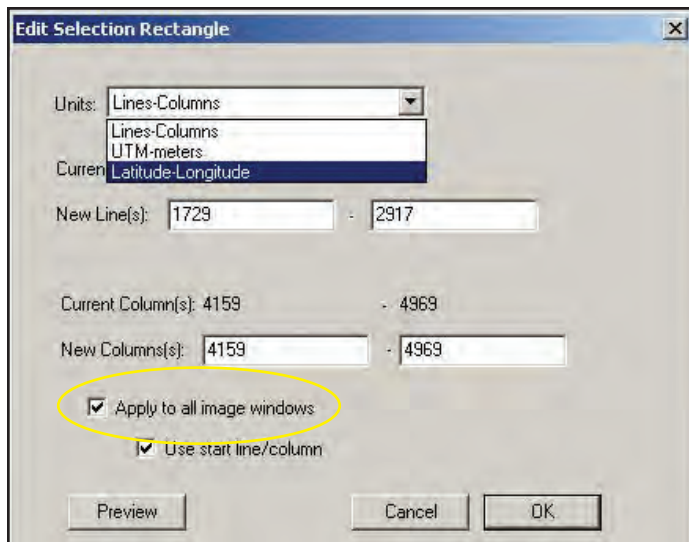6. In the "Edit Selection Rectangle" window, check the box next to "Apply to all image windows."

July 8, 1991 — Landsat 5   **August 1, 2000 — Landsat 5**   **April 7, 2010 — Landsat 5**

7. In the "Units" drop-down, choose "Latitude-Longitude."

8. Click OK.
9. Now the exact same area is selected in the other images. For all three images, follow the cropping procedures as described in the "Using MultiSpec to Interpret Satellite Imagery" section, "How to Crop" (Step 6).
10. Now you can compare the images.

Analysis and Interpretation

Essential Questions

1. Open the cropped image you chose in the MultiSpec Application section above, how many airport runways can you find?
2. In the area you chose in the MultiSpec Application section above, what do you think the bumpy looking features could be?
3. In the entire Phoenix region, what natural land features are affecting the shape of the urban area? Explain your choice.
4. Select the 2010 image and go to Lat. 33.671, Long. -112.000. At this point, two highways intersect; Highway 51 runs north-south and Highway 101 runs east-west. Now go to the 2000 image. You should be able to see that these highways are under construction at this time. In the 1991 image, they do not yet exist. What other changes in this location can you spot between 1991 and 2010?
   a. What effects do new highways have on a location?
   b. Locate other highways you think might be under construction in the 2010 image.
   c. What do you think the large rectangles northwest of this intersection might be?
5. Which of the commonly used band combinations from the MultiSpec Introduction reveals vegetation the best? Explain your decision.

Extended Learning

1. In the area you chose in the MultiSpec Application section above, find a few golf courses. Golf is popular in Phoenix because of the year-round nice weather. Compare the 1991 and 2010 images. In which image are there more golf courses? Choose a different rectangle in the image and count the golf courses there. You have now developed a random sampling of data. Compare the number of golf courses between the two rectangles you chose. Check with others in the class and compare results.
2. In most of the residential areas, streets are laid out in roughly a square pattern. Most are 1 square mile in size. Use MultiSpec to convert 1 square mile to square kilometers, acres, or other units of area.
   a. Can you find any neighborhoods that do not use this pattern?
3. As a city planner, you are tasked with guiding the growth of the city. In which direction do you think the city of Phoenix and its suburbs can most easily expand? What obstacles might prevent expansion in other directions? Explain your answers.
4. A city engineer wants to know what band combination best shows streets. What do you recommend?
5. At the lat-long coordinates of 33.544°, -111.8654° in the 2010 image, you can see a golf course. There appears to be a lot of land that is not urban around it. And to the south are some rectangular shapes, which indicate farm fields. How can you account for this type of land cover in the midst of the urban areas?
6. In any of the three entire images, identify any specific location that looks intriguing. A weird shape or color, or a place that seems puzzling. To learn more about it, you may need to do further research. Try finding the same place on Google Earth and see if it provides more clues about your area of interest.

Lesson Extension: Scavenger Hunt

Using any of the three entire images, see if you can find the following features or structures. Provide the latitude/longitude coordinates of the locations.
- Automobile racetrack
- Stadium (hint: structure has a white roof)
- Lake
- Highway or freeway interchange
- Crop fields that are circles
- A place where the edge of a residential area is right up against desert
- Where you would likely get a good view of agriculture from a highway