Tracking Change Over Time—River Flooding

Background

These three Landsat 5 images show a flood in southern Indiana and Illinois. Peak flooding was observed in this area on June 10 and 11, 2008. The clear Landsat scene from June 11, 2008, and the clear image of "normal" conditions from June 9, 2007, allow us to compare the scenes and see exactly what damage a flood of this magnitude can cause.

Rainfall amounts ranging from about 2 inches (in.) to more than 10 in. fell in this area on June 6–7, 2008. Because of a wetter than normal spring, this heavy rain fell on already saturated ground. The rivers quickly rose to exceed flood stage.

The following files are the images to use in MultiSpec:

- Flood_June2007.tif
- Flood_June2008.tif
- Flood_July2008.tif

June 9, 2007—Landsat 5

June 11, 2008—Landsat 5

July 13, 2008—Landsat 5

Analysis and Interpretation

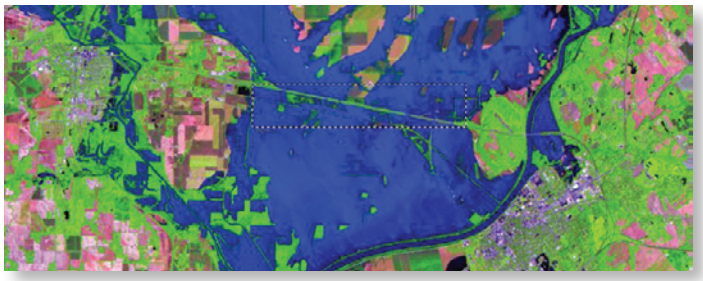
Essential Questions

1. What band combination best shows rivers?
2. Identify an area of farmland that is inundated.
3. Find a flooded area that covers at least an entire section (640 acres). (See "Using MultiSpec to Interpret Satellite Imagery," step 7, for instructions on how to calculate area.)
4. Identify at least one city/town that was affected by this flood. Recall the list of common band combinations from the "Using MultiSpec to Interpret Satellite Imagery" section. You may also need to use Google Maps or Google Earth to identify cities.
5. In the 2008 flood image, what could account for the large, nearly square-shaped area of floodwater at lat/long 39.31, –87.23? How many acres does it encompass?
6. In the 2008 flood image, at about lat/long 39.31, –87.58, there seem to be rectangular islands in the middle of the water. What could be causing these areas to appear unflooded?
7. In the 2007 image, a large area at about lat/long 38.76, –87.59, band combination 5,4,3, contains some green fields, but some fields are maroon and others pink. Why are these fields different colors?

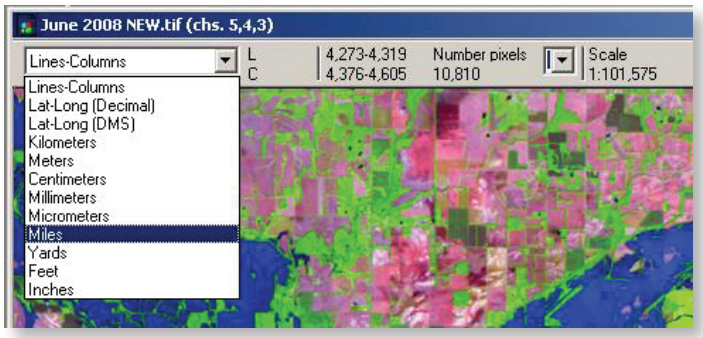
MultiSpec Application: Using the Pythagorean Theorem to Calculate Distance

In the June 2008 flood image, locate the cities of Vincennes, Ind. (lat/long 38.68, –87.52), and Lawrenceville, Ill. (lat/long 38.72, –87.60). A straight highway (Highway 50) connects the two cities and seems to be traversing a large flooded area. Use MultiSpec to find out how many miles of flooded area this highway passes through.

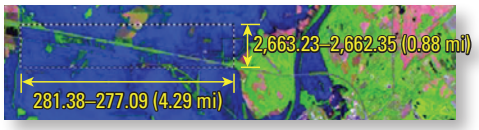
1. With the mouse, select a rectangle so that either end of the highway is in the opposite corner of the rectangle (see image).



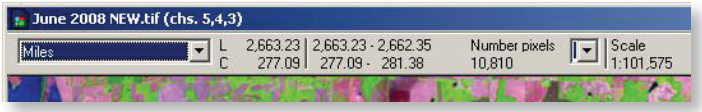
2. Under the Window menu, select Show Coordinate View. Change the units to miles.



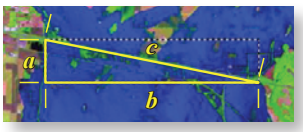
3. Notice how the range of numbers is now shown as a range of miles. These numbers represent the dimensions of the rectangle you drew on the MultiSpec image in miles.
   - The length of the short side of the rectangle is 2,663.23–2,662.35 (0.88 miles).
   - The length of the long side of the rectangle is 281.38–277.09 (4.29 miles).



   - The exact dimensions of your rectangle might be a little bit different from the given numbers here. That's okay. We should come up with almost the same answer.



4. You can now calculate the distance from one corner of the rectangle to the other using the Pythagorean theorem ($a^2+b^2=c^2$). The answer will be the length of that stretch of highway. Notice that the rectangle can be seen as two right triangles on top of each other.



   - c is the length of the hypotenuse of the right triangle (the diagonal line), and a and b are the lengths of the other two sides.

5. Insert the numbers you found for a and b above into the formula:

$$0.88^2+4.29^2=c^2$$
$$0.7744+18.4041=c^2$$
$$19.1785=c^2$$

6. Now we need the square root (√) of that number to solve for c:

The square root of 19.1785 is about 4.38. $\sqrt{19.1785} = 4.38$

7. The length of highway that crosses this flooded area is about 4.38 miles. Let's make sure this answer makes sense. The length of the diagonal line in the rectangle should be a little bit longer than the longest side of the rectangle. 4.38 is a little longer than 4.29, so our answer makes sense.

Extended Learning

Floods are examples of short-term environmental change. They cause substantial damage and change for only a short time, such as a couple of weeks. The damage done to crops can last for an entire growing season, but in most cases, the landscape goes back to normal after the floodwaters recede. In some cases, however, a flood can cause more lasting change.

Downstream from the area that we studied for this module, the flood changed the course of the Wabash River just above where it flows into the Ohio River. We have to go to a different Landsat image to see this happen, the one just south of the scene we've been examining. Images show a new cutoff that was formed from this flooding.

Open the following images:

Cutoff_6-9-2007.tif	Landsat 5	Cutoff_6-4-2011.tif	Landsat 5
Cutoff_6-11-2008.tif	Landsat 5	Cutoff_6-14-2012.tif	Landsat 7
Cutoff_7-13-2008.tif	Landsat 5	Cutoff_8-28-2013.tif	Landsat 8
Cutoff_6-30-2009.tif	Landsat 5	Cutoff_8-15-2014.tif	Landsat 8
Cutoff_8-4-2010.tif	Landsat 5	Cutoff_8-2-2015.tif	Landsat 8

- Use the August 2, 2015, image to estimate the area of the land that is now inaccessible.
- Estimate how much this new cutoff shortens the Wabash River.
- In the 7,4,1 (7,5,3 for Landsat 8) band combination, the color pink indicates barren soil, which includes farmland that is either not planted or planted but the crops have not grown yet, or sediment in a river. Why does sediment appear in some parts of the river and not in others?
  - Change the band combination to 3,2,1 (4,3,2 for Landsat 8). How does river sediment appear?
- What issues arise concerning the farmers who own this land that is now surrounded by the river?
- Do you have any ideas about what to do with this land now?

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.

- **Oxbow lake:** a U-shaped lake next to a river, formed when a curve, or meander, in a river gets cut off from the river's main flow
- **Meander scars:** the shape of an old oxbow lake after it has dried up or has been filled in with sediment and soil; several meander scars can be seen from space next to meandering rivers
- **Forested area**
- **Center-pivot irrigation field**
- **Highway**
- **Highway interchange**
- **Reservoir (artificial lake)**
- **Widest spot on a river during the flood**

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