Asa Hayes

GEOG-361-502 (Thurs.)

Due 7 March 2019

Lab 04: Fundamentals of Multispectral Remote Sensing

Question 1. Which image shows high water conditions, and which image shows low water conditions?

The image from 30 Aug. has the higher water conditions of the two. Using the "band-10_11" image from each date to keep the water distinct, we have two main factors setting the 30 Aug image as having higher water. First, as the used images were in the thermal band, we are able to tell that as the water is darker in the 30 Aug image, it is cooler than the Aug 15 image, and deeper bodies of water tend to be colder. This is confirmed by the more concrete other indication, which shows that some of the small river-islands visible in both images are also visibly submerged in the Aug 30 image. A good example is the small branching section near the top-left corner.

Question 2. Using the image acquired on August 30th, 2013, examine the different bands individually (Bands 1-11). For each one, briefly describe what kinds of features are most visible, and which are relatively difficult to characterize. Which band(s) do you think will be most useful in characterizing water?

Band 1: Tells of approximate coloring, basically only light vs dark colors. Seems to only be good individually for distinguishing highly contrasting elements (ex. Sand/snow vs regular terrain)

Band 2: Very similar to Band 1, but slightly darker overall

Band 3: Land is much lighter in this band, lending to easier characterization for land vs water. Elevation however is not very discernable still, all the land is approximately the same color.

Band 4: Band 4 appears to show areas of vegetation very well in dark spots. It is harder to tell apart the water in this image, as the tones are similar.

Band 5: This band looks to have everything besides water in very light shades, with water being very dark and separated, very good for distinguishing water. But, little detail about land is retained.

Band 6: Similar to Band 5, water still very clearly delineated, but a bit more topographical detail is present.

Band 7: Water is yet still very clearly separated, and more surface detail (not necessarily elevation) is visible than Band 6.

Band 8: Band 8 was not included for the 30 August image.

Band 9: Band 9 is extremely grainy, with the river being barely visible. This layer may be detecting some atmospheric obstruction or clouds between the sensor and the ground.

Band 10: To start, this band is lower resolution than the others. It is most visually similar to Band 6 due to the brightness, but the changed spectrum indicates a slightly different factor as being primarily sensed. Upon review of Band Specifications (see website in Question 3), this is due to Band 10 (& 11) sensing temperature, which is tied to moisture, Band 6's main detection element.

Band 11: Similar to band 10, but sharper and more saturated.

Question 3. Bands 10 and 11 are somewhat different from the other bands. What do they show you? What are two fundamental ways in which bands 10 and 11 differ from the other bands?

Bands 10 and 11 are thermal-infrared bands, which show temperature rather than what is actually visible. From https://landsat.gsfc.nasa.gov/landsat-data-continuity-mission/ we can see that the specifications of Bands 10 and 11 are very different than that of the other bands. They measure a much longer wavelength than any other bands (10.6-12.51μm vs next highest at 2.294 μm) but also have a much lower resolution (100m vs 15-30m in other bands)

Question 4. Now combine the different bands into a series of different RGB composites. Identify the composites that you would find most useful in performing the following tasks:

a) RGB visible (what you'd see with your eyes): The most useful composite for just a regular RGB image would be Bands 2-4, because those are the bands directly made for detecting each section of light. (Band 2 = Blue, 3 = Green, 4 = Red)
b) Differentiating water from vegetation: The most useful composite for a water vs land image would be Bands 5-7, because bands 6 and 7 (set as B and R respectively) clearly delineate the water while Band 5 (set as green) is infrared, which senses vegetation well.
c) Differentiating vegetation of different types: The most useful composite for a vegetation map image would be Bands 2-4, as the darkness/density of a vegetation area usually indicates different types of vegetation, especially when delineated in shades of green from the visible spectrum.
d) Differentiating water with lots of sediment suspended in it from very clear water: The most useful composite for a sediment saturation map image would be Bands 2-4, because no other bands (besides Band 1 to a low degree) have a high degree of visible separation between high and low sediment areas. Band 3 has the best distinction without other visually confounding areas. One of the better visible spots for seeing the change in sediment density is the intersection near the top-left, where the main river splits into a smaller stream and the water is visibly less clouded.

Question 5. What is the total inundated area (measured in km2) in each image? What is the difference in inundated area between the two images?

From the 30 August image information, pixel resolution is 30m or 0.03km/pixel. From statistics on a black/white mask found from a composite of Bands 5-7, the amount of water in pixels was 736646. 736646px * 0.03km/px = 22099.38km or 148.6586km^2.

Using the same process for the 15 August image, there is a result of 132.3188km^2.

The difference in inundated area between the two images is 16.3398km^2.

Question 6. What is the approximate length (in km) of the river reach shown in the two images?

Using the straight line measurement tool, the length of the river visible in this image is 64km.

Question 7. If you assume that 95% of the inundated area in each image is part of the Lena River, what is the difference in the average width (in km) of the Lena River between the two images?

Use area from 5, length from 6, give as approx. rectangle, A = l * w

Using regular area formula Area = length * width, we can find and compare the areas:

(148.6586km^2 * 0.95) = 64km * w → w = 2.2067km

(132.3188km^2 * 0.95) = 64km * w → w = 1.9641km

2.2067km - 1.9641km = 0.2425km

The difference in river width between 15 and 30 August is approx. 0.2425km

Question 8. In order to avoid a horrible death involving being trampled by the governor's immense reindeer herd, create for him a single image that identifies both (a) areas inundated at low water and (b) areas inundated at high water. Include this map in your final report, following good cartographic principals to the extent possible in ENVI (e.g. include labels and a scale).

Composite uses Band 7 from 15 Aug as R, Band 7 from 15 Aug as G, and Band 6 from 30 Aug as B. I was not able to find a way to export the whole-map image with annotations intact, so this is a screenshot of the finished map.