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Identifying and Analyzing the Borgen Project in visible and VNIR wavelengths using ENVI, captured using ASTER

Abstract

The purpose of this paper is to outline the method and resulted used while analyzing an image captured from the ASTER sensor using the ENVI software package. One image of an experimental farming site is Saudi Arabia was analyzed in grayscale, R, G, B, false color and NDVI in order to determine the location and levels of vegetation. Methods included looking at DN values, statistical data regarding DN values, the absorption and reflectance of certain wavelengths (namely NDVI). Levels of healthy vegetation were analyzed using NDVI transformations.

1. Introduction

The Advanced Spaceborn Thermal Emissions and Reflection Radiometer (ASTER) is a satellite sensor which images the earth in 14 distinct wavelengths. ASTER is one of the only remote sensing satellites which records images in high resolution. Changes on the surface of the earth are more easily detectable with higher resolution spatial imagery; moreover, analysis requiring higher levels of detail can be performed using ASTER data. The goal of this lab was to analyze an image captured by ASTER using the ENVI software package, more specifically, to review the metadata and ultimately identify what that the image contained. Using ENVI, the DN values for regions in the image are able to be identified. Using the DN values, color analysis, and a series of image stretches/enhancements, as well as cross referencing the geospatial data with Google Earth images, the final location and composition of the area was able to be identified.

2. Methods

Identifying the wavelengths that this image was captured in was the first crucial step in analysis. This metadata showed that the image was captured in the visible near infrared spectrum (VNIR). After determining the wavelength region, more metadata concerning the image size was investigated. The number of bands and pixel was determined to be 3 and 3800, respectively. Using the appropriate metadata, the actual size was able to be calculated by multiplying the number of pixel by the pixel size. The size (on the ground) was determined to be 57 km in length.

2.1 Gray Scale Image Analysis

After loading the grayscale image, the environment was observed, showing lots of gray and while circles of varying sizes. The DN values were quantified for some of the brighter areas, reading as high values (closer to 255). A custom (user-defined) linear stretch was applied to the image within the DN range from 129 to 255. The image was then reset and statistical data from bands 1 and 3 was analyzed (See image 1). After this, the pixel locator was brought up and a specific pixel (1083, 3468) was located and the DN value was recorded. The center pivot irrigation circle in the pixel was then measured using the ENVI measurement tools and the area was calculated using the radius.

2.2 Google Earth Confirmation

Now, the R, G, B color image was loaded in, using bands 2, 3, and 1, respectively. After loading the image, the colors were enhanced using the scroll equalization stretch. Several of the other stretch options were tried during this time as well. The pixel locator was then used to pull up another specific pixel (1815, 2071) and the pixels DN values were noted: R = 27, G = 6, B = 103.

2.3 Normalized Difference Vegetation Index (NDVI) analysis

The final analysis consisted of an NDVI transformation. ENVI was used to bring up a new NDVI window, using the transform function. After loading in the correct number of bands for the red and near infrared, the new image was loaded in grayscale. After seeing the grayscale result, a color NDVI image was loaded in, using bands 2 as R, NDVI as G and band 1 as B. The image was then slightly modified before it was saved.

3. Results and Analysis

The gray circles in the grayscale image were determined to be center pivot irrigation circles, with varying levels of vegetation in them. This could initially be clued by the DN values for each of the different areas. The brighter areas indicated more reflectance. Applying the user-defined stretch from DN 129 to 255 caused the lighter areas to become lighter and the darker areas to become darker. The value of 255 was chosen as the max to allow the stretch to push the colors towards their more extreme versions, the max of which being 255 for white and 0 for black. The statistical data indicated slight changes in the mean for DN values, indicating that the color bands were different from band 1 to band 3. Using google earth, the true colors of the image were revealed to be similar to the color bands loaded in ENVI. The colors were indicative of heavy vegetation in some areas, surrounded by arid, sandy or rocky areas (outside of the farmland). The reasons that the specific bands were assigned R, G, B was simply that the wavelength (in nm) which the bands were sensed in, corresponded to that color on the electromagnetic (EM) spectrum. Furthermore, brief uses of false color allowed further ability to distinguish between features before loading the NDVI transformation. Utilizing the EM spectrum is what allowed NDVI to be visualized, using the bands given (see image 2). Assigning NDVI to the green band allowed ENVI to identify the amount of red and near infrared light, in order to calculate the net photosynthesis happening on the ground. The healthy plants absorb red light and reflect almost all green light.

4. Conclusion

The area in question was identified as the Borgen Project, which is an experimental farming site located in Saudi Arabia. Through a mix of grayscale, R, G, B and NDVI imaging processes (outlined in this paper), the shapes of the irrigation circles, along with their color and levels of healthy vegetation were able to be identified. The calculated area of the irrigation circle also helped to give a sense of scale before being cross-referenced using Google Earth imagery.

5. References

ASTER: Advanced Spaceborne Thermal Emission and Reflection Radiometer. asterweb.jpl.nasa.gov. Accessed 12 Oct. 2022.

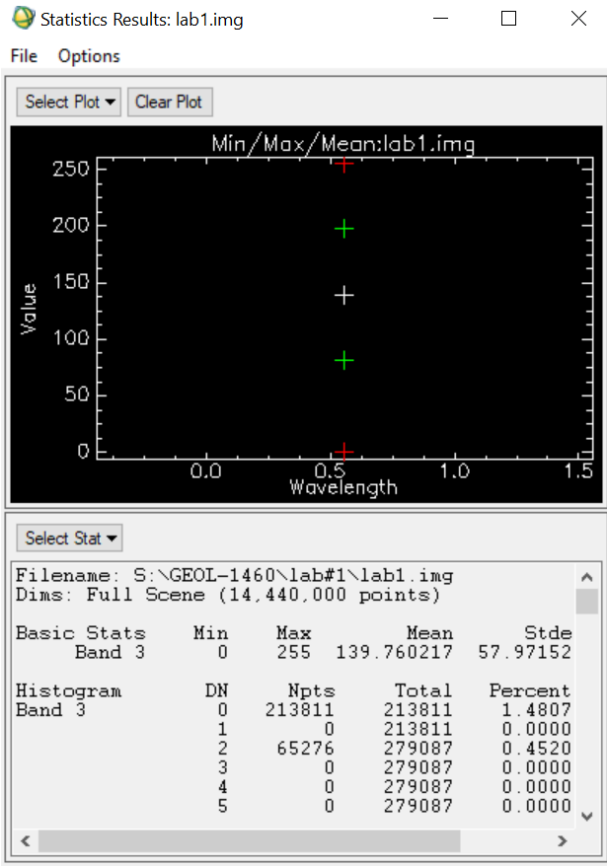

Image 1: Statistical Data taken from Band 3

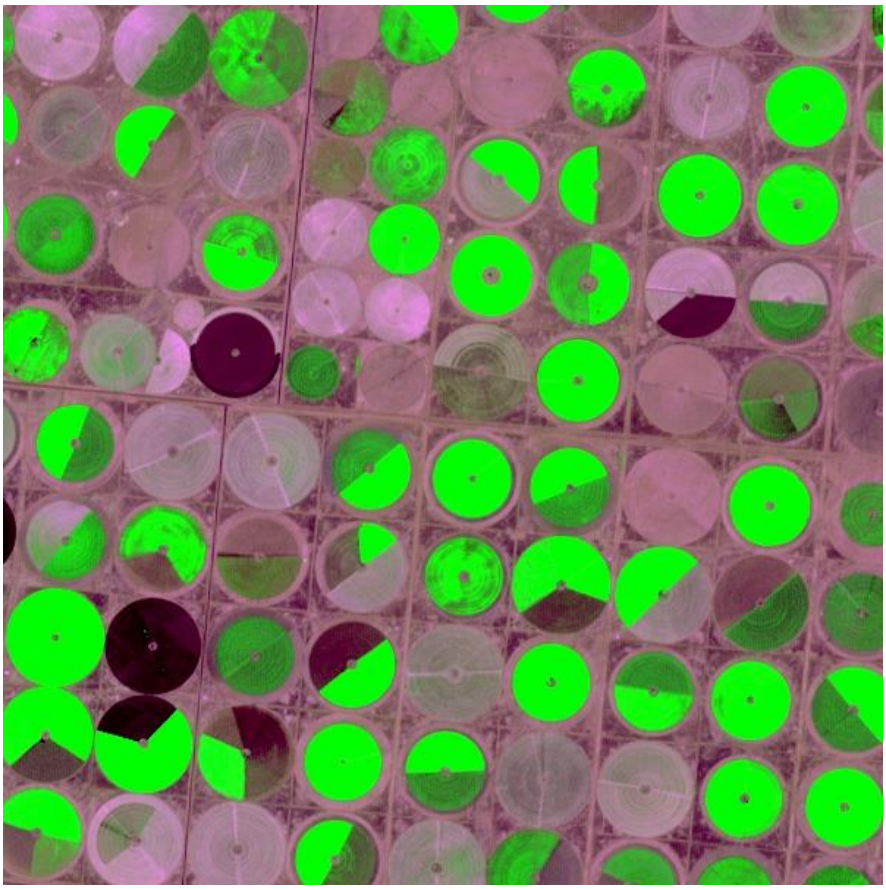

Image 2: False Color NDVI