A
Report On:

Vegetation Indexes

"MONDAY 01/07/2019"

By

Avinash Kumar Singh

DronaMaps Private Limited
NASSCOM CoE-IoT, Hartron Innovation Campus
Udyog Vihar Phase 1, Sector 20, Gurugram
Haryana - 122022

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Calculating the Vegetation Indices

1.1 INTRODUCTION

A vegetation index (also called a vegetative index) is a single number that quantifies vegetation biomass and/or plant vigor for each pixel in a remote sensing image. The index is computed using several spectral bands that are sensitive to plant biomass and vigor. The most common vegetation index is the normalized difference vegetation index (NDVI). NDVI compares the reflectance values of the red and near-infrared regions of the electromagnetic spectrum using the following formula: NDVI=(NIR-RED)/(NIR+RED), NIR is the pixel's reflectence value in the near-infrared band RED is the pixel's reflectence value in the red band The NDVI value, which ranges from -1.0 to 1.0 for each pixel in an image, helps identify areas of varying levels of plant biomass/vigor. Higher values indicate high biomass/high vigor.

1.2 Types Of vegetation Index

1.2.1 Normalized Difference Vegetation Index (NDVI)

- Live green plants absorb solar radiation in the photosynthetically active radiation (PAR) spectral region, which they use as a source of energy in the process of photosynthesis.
- NDVI is calculated from the visible and near-infrared light reflected by vegetation. Leaf cells scatter (i.e., reflect and transmit) solar radiation in the near-infrared spectral region.

$$\text{NDVI} = \frac{(\text{NIR} - \text{Red})}{(\text{NR} + \text{Red})} \tag{1.1}$$

where RED and NIR stand for the spectral reflectance measurements acquired in the red and near-infrared regions, respectively. NDVI itself thus varies between -1.0 and +1.0.

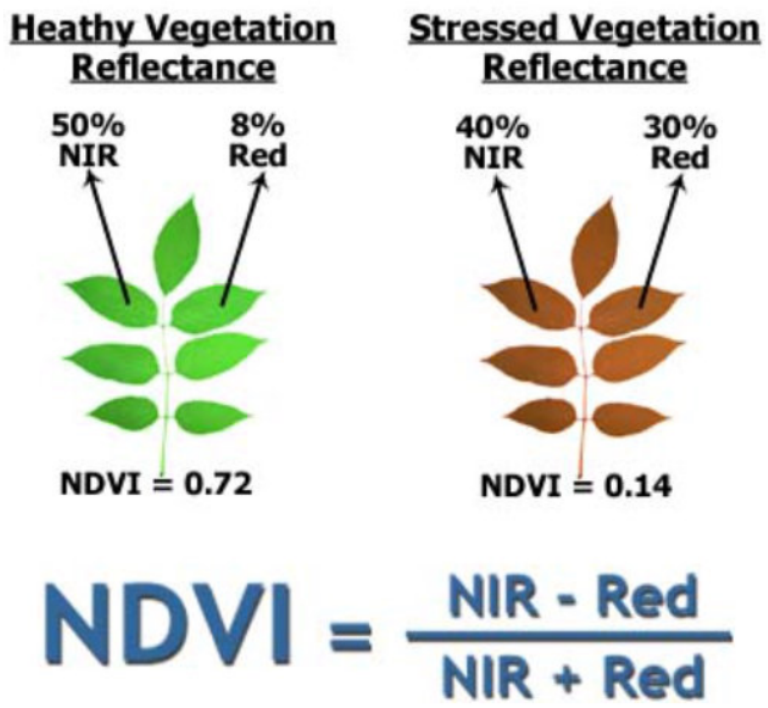

Figure 1.1: NDVI

Characteristic NDVI Signatures

Characteristic NDVI Signatures

– NDVI of dense vegetation canopy will tend to positive values (say 0.3 to 0.8) Clouds and snow fields will be characterized by negative values of this index.

– Free standing water (e.g., oceans, seas, lakes and rivers) which have a rather low reflectance in both spectral bands (at least away from shores) and thus result in very low positive or even slightly negative NDVI values.

– Soils generally exhibit a near-infrared spectral reflectance somewhat larger than the red, and thus tend to also generate rather small positive NDVI values (say 0.1 to 0.2).

–Very low values of NDVI (0.1 and below) correspond to barren areas of rock, sand, or snow.

–Moderate values represent shrub and grassland (0.2 to 0.3),

–High values indicate temperate and tropical rainforests (0.6 to 0.8).

Figure 1.2

Analysing Each Band Of RGB Raster Image:

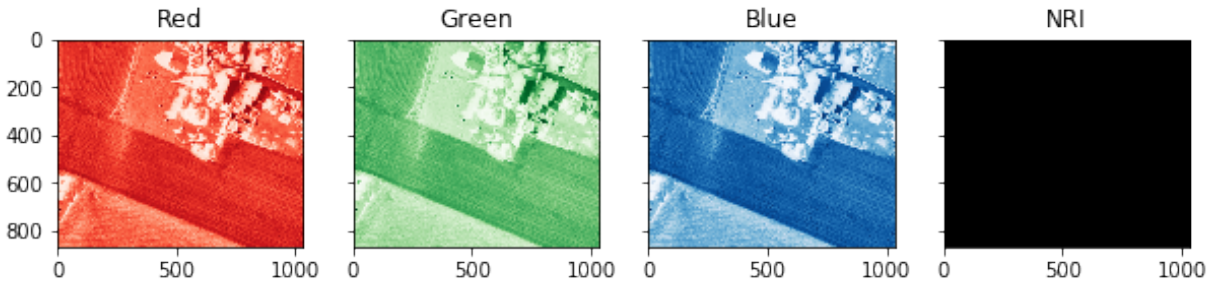

Figure 1.3: Band Analysis

Figure 1.4: Raster Sample Image

Figure 1.5: NDVI Result

1.2.2 Visible Atmospherically Resistant Index(VARI)

The Visible Atmospherically Resistant Index (VARI) was designed and tested to work with RGB sensors. VARI is a measure of "how green" an image is. VARI is not intended as a substitute for an NIR camera, but it is meaningful when working with non-NDVI imagery. RGB images with the VARI algorithm applied make it possible to detect areas of crop stress in a field.

$$VARI = \frac{G-R}{G+R-B} \tag{1.2}$$

Figure 1.6: VARI Result

1.2.3 Transformed Vegetation Index(TVI)

The Transformed Vegetation Index (TVI) proposed by Deering et al. (1975) is aimed at eliminating negative values and transforming NDVI histograms into a normal distribution.

$$TVI = \sqrt{\left(\frac{R_{NIR} - R_{RED}}{R_{NR} + R_{RED}}\right) + 0.5} \tag{1.3}$$

Figure 1.7: TVI Result

However, it cannot be calculated when NDVI < 0.5.

1.2.4 Ratio-Based Vegetation Index

The Ratio Vegetation Index (RATIO) was proposed by ROUSE et al. (1974). This technique is characterized by limited applicability as for vegetation assessment. Firstly, it does not allow to eliminate the effects of topography and variations in the sun illumination angle, so that the output images reflect only the presence of green vegetation. Secondly, RATIO images do not have normal distribution and, in consequence, desirable statistical properties.

$$RS = \frac{R}{NIR} \tag{1.4}$$

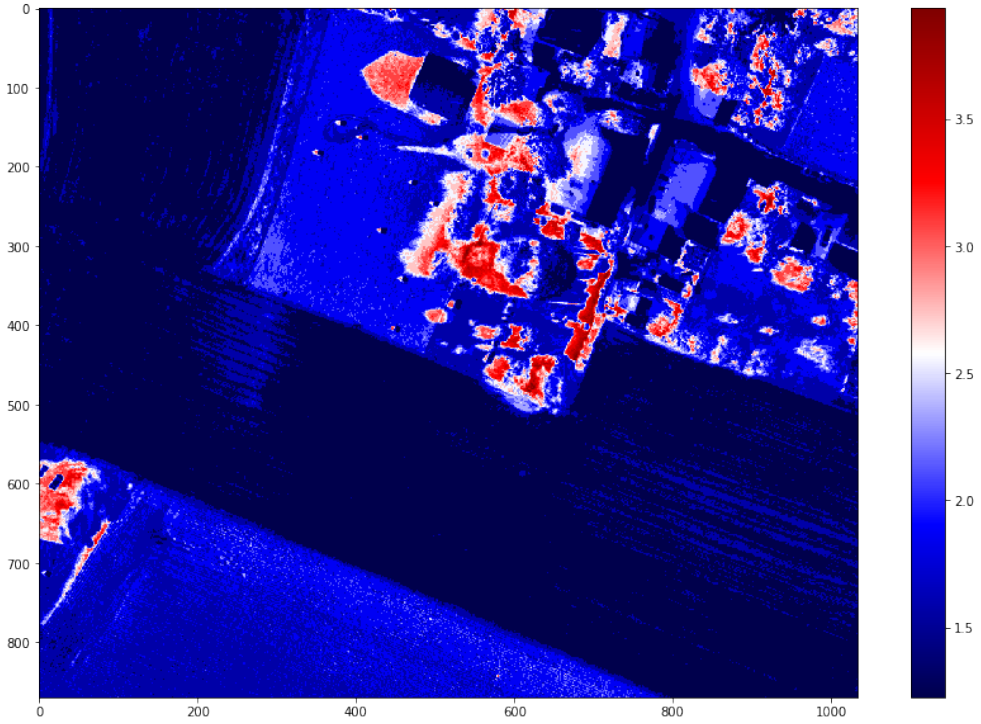

Figure 1.8: Ratio Vegetation Index

1.3 Conclusion

- Vegetation Indices should highlight the amount of vegetation, the difference between vegetation and soil, and they should reduce atmospheric effects.
- Soil background effects should be minimized if possible.
- Indices can be customized for particular applications.

Code on Github: https://github.com/avinash2222/GIS

1.4 References

- https://rasterio.readthedocs.io/en/stable/quickstart.html
- https://skyglyph.freshdesk.com/support/solutions/articles/9000136160-what-are-index-maps-ndvi-gndvi-vari
- https://rasterio.readthedocs.io/en/stable/quickstart.html