Journal scientific and applied research, vol. 23, 2022
International Journal

Original Contribution

ISSN 1314-6289

REMOTE SENSING OF THE STATE OF THE VEGETATION COVER OF THE TERRITORY OF THE BULGARIAN BLACK SEA

Neli Zdravcheva

GEODETIC FACULTY, UNIVERSITY OF ARCHITECTURE, CIVIL ENGINEERING AND GEODESY, SOFIA, str. "Hristo Smirnenski" 1

E-mail: neli_z@abv.bg

ABSTRACT: *This paper is devoted to the multispectral processing of satellite images in order to establish the actual state of the vegetation cover. As a result of conducted experiments, the vegetation on the territory of the Bulgarian Black Sea coast was studied. For this purpose, new indexed images have been generated from appropriately selected multispectral images, which visually reveal the actual state of the vegetation cover and provide objective and timely data. They could serve to manage and other decisions (in the field of ecology, forestry, agriculture, etc.), for environmental assessments and expertise, for scientific research and other projects.*

KEYWORDS: *multispectral images, vegetation cover, spectral indices, spectral indices, ecology*

1. Introduction

Over the past years, the state of the environment has been increasingly deteriorating. This gives rise to the need to carry out both in-depth fundamental studies of the various components of the ecosystems (vegetation, water, soils, etc.) and to undertake various practical actions for effective control of their condition. In this regard, the paper reveals some aspects of the significant role that modern photogrammetric and remote sensing methods (FDM) have in providing objective, generalized, economically beneficial, ubiquitous, accessible and reliable geospatial information about the real state of the environment.

2. The nature of vegetation indices in short

The presence of mutual correlation between the individual multispectral satellite images obtained in different ranges of the electromagnetic spectrum provides an opportunity to derive some derivative functions of the spectral brightness, which are selected in such way as to reveal the most characteristic properties and the most important parameters of the studied objects. In [1], the author examines some transformations of multispectral satellite images, giving special attention to the nature and methods of obtaining the so-called soil line as well as a number of vegetation indices such as NDVI, SAVI, NDWI, ARVI, EVI, PVI, etc.

It can be said, that spectral transformations are unique methods for automating and optimizing the processes related to the decoding of multispectral images. The creation and analysis of the derived features itself is essentially an interactive controllable threshold classification of digital images. The division of the set of objects into classes is based on features that are obtained through various combinations, and the threshold values of the new features are entered by users, being selected on the basis of a priori information about the studied objects. The determination of different indices is a typical example of the practical use of spectral transformations. Since the physiological state of the plant cover is largely determined by the chlorophyll content and the degree of moisture security, it is appropriate to use relative indicators of the state of the vegetation. The relative vegetation index NDVI is such an indicator of the state of the vegetation and in its essence is a kind of indicator of the amount of photosynthetically active biomass and is calculated according to the following formula [2]:

$$NDVI = \frac{\rho_{NIR} - \rho_{RED}}{\rho_{NIR} + \rho_{RED}} \qquad (1)$$

In the above formula, ρ_{RED} is the spectral brightnesses in the red and near-infrared ranges, respectively.

The calculation of NDVI is based on the use of two of the most stable sections of the spectral curve of the reflectance of higher plants - in the red region of the spectrum (with a wavelength of 0.6–0.7 μm) lies the absorption maximum of solar radiation from chlorophyll, and in the infrared region (with a wavelength of 0.7–1.0 μm) is the region of maximum reflection of the cellular structure of the leaves [1]. High photosynthetic activity, which is generally associated with dense vegetation, causes less reflection in the red range of the spectrum and more in the infrared. It is the study of the relationship of these indicators to each other that allows us to clearly distinguish vegetation from other objects on the earth's surface. In addition, the use of the normalized difference between the minimum and maximum reflectance allows to reduce the influence of such external factors as for example, differences in image illumination, fog, absorption of solar radiation by the atmosphere, etc. For reading the NDVI vegetation index, either a continuous gradient or discrete scale is used, showing values in the range of -1 to 1, or a so-called scaled scale, which has values in the range of 0 to 255 (corresponding to the number of gradations of gray color).

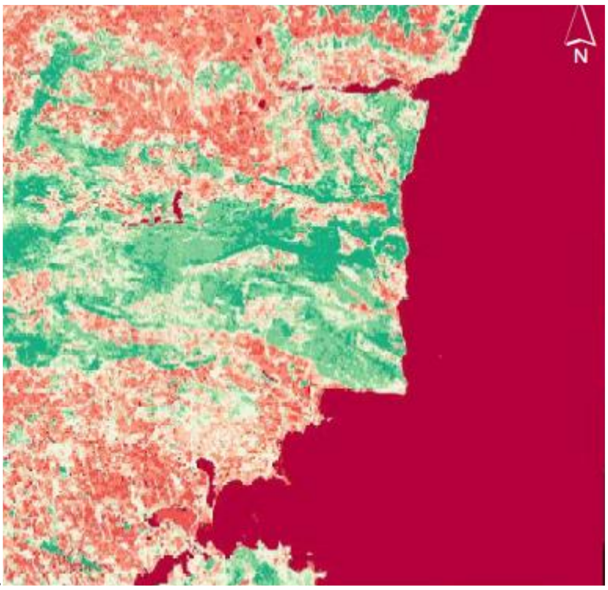
For soil and dry vegetation, NDVI values are positive and close to 0. NDVI takes maximum values for areas with vegetated vegetation and intermediate values for different states of vegetation cover. Its values increase with the development of green biomass and decrease with its drying. NDVI values can be determined based on different images having spectral channels in the red and infrared ranges. Algorithms for calculating NDVI are currently being built into a number of software packages.

3. Indexed images of a part of the territory of the Bulgarian Black Sea

For the purposes of the present experiment, multispectral images taken with Sentinel 2A in 12 channels were used. For the visualization of a given object, images obtained by combining different spectral zones can be used. In the current case, RGB visualization obtained from the red, green and blue channels was selected for the territory of the Bulgarian Black Sea. The final image that was obtained can be seen on Fig. 1.

Figure 1 Obtained image from the Bulgarian Black Sea

The images are pre-processed to improve the quality of their radiometric characteristics (which includes optimizing their histograms, changing contrast, brightness, de-noising, etc.). The images received by Sentinel-2 are in WGS84 coordinate system, UTM projection and coordinates are latitude and longitude. The images used for the experiment were orthorectified after capture during processing at Sentinel's ground control centers. After performing the considered transformations and preliminary preparation, indexed images were generated based on different vegetation indices. A newly created indexed NDVI image can be seen on Fig.2



Figre 2 NDVI indexed image

On the classic satellite photo, the captured vegetation is well recognized by its areas, which are colored in different shades of green – the natural color of the foliage. Images obtained as a result of multispectral analysis, with NDVI values, traditionally look like black and white images with 256 degrees of gray. Usually, to improve visualization and to make the final results easier to read, some range of colors is used. NDVI values are usually visualized in the color range from red through yellow and green [1]. The interpretation of NDVI values is shown on Table 1 [4].

TABLE 1
NDVI values

NDVI	INTERPRETATION
0 – 0-1	Bare ground cover
0.1 – 0.2	Almost no ground cover
0.2 – 0.3	Very low ground cover
0.3 – 0.4	Low ground cover
0.4 – 0.5	Medium ground cover
0.5 – 0.6	Medium ground cover
0.6 – 0.7	Medium high ground cover
0.7 – 0.8	High ground cover
0.8 – 0.9	Very high ground cover
0.9 – 1	Entire ground cover with healthy vegetation

As can be seen from the indexed image and from Table 1, the highest NDVI values characterizing areas with dense vegetation cover are depicted in deep green, and areas devoid of vegetation (such as anthropogenic sites, bare rocks, plowed fields, etc.) n.) are depicted in deep red.

4. Conclusion

The considered methodology could also serve for the implementation of ecological monitoring, with similar studies being carried out during a certain period (for example, in one year) in order to track the changes in the area and the condition of the vegetation. The information from the generated indexed images can serve various purposes: the creation of specialized thematic maps -

for example, about the actual ecological state of the Bulgarian Black Sea coast; for categorization of forest massifs [4], for various ecological, statistical, management and other analyses; to study the real state of plant diseases and agricultural plantations. These data make it possible to determine not only the state of the ecosystems at the time of the filming itself, but also for the study of the dynamics, for the implementation of ecological monitoring of the respective territories [2], [3] . The supplied information and the created products such as plans, maps, GIS layers and others are extremely useful and practically irreplaceable for providing data for making management decisions in the event of various natural disasters, for environmental assessments and expertise to establish the real state of natural objects, for research and other projects. Their advantages and their leading role in providing information for various environmental purposes are indisputable.

REFERENCES

[1] Zdravcheva N., Modern means for environmental monitoring - UACG, Second scientific and applied conference with international participation "Management of projects in construction" November 5 - 6, 2015.

[2] Zdravcheva, N., Spectral transformations of multi-zone satellite images, International Jubilee Scientific Conference 75 years of UACG, November 2017

[3] Tsarovska S., "Categorization of forest massifs using LIDAR data, National Conference "Development of photogrammetric technologies and their application in practice", 2018 UACG

[4] Tsarovska S. "Multispectral images for vegetation monitoring", National conference "Development of photogrammetric technologies and their application in practice", 2019, Bulgarian Academy of Sciences