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*Original Contribution*

# INFORMATION EXTRACTION FROM MULTISPECTRAL SATELLITE IMAGES

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***Abstract:*** *The article analyzes various methods and approaches of modern remote sensing that can be used in the processing of multispectral satellite images in order to effectively extract visual information about territories for which preliminary data is not available. Attention is paid to the creation of new derivative images (synthesized and indexed) and to performing pixel-oriented computer non supervised classification. A series of experiments have been made that clearly reveal the advantages and conveniences of remote retrieval of information from multispectral satellite images in a territory for which reference objects and other data acquired in situ are not available.*

***KEY WORDS:*** *multispectral images, synthesized images, vegetation cover, spectral indices, computer classifications*

## 1. Introduction

An important condition for the successful management and functioning of modern society is the provision of objective, timely and economically effective information about the real state of the earth's surface and the objects located on it. Currently, the possibilities that remote sensing (RS) provides for its provision are practically without an alternative. Their main task is to determine the actual condition of specific territories on the earth's surface. Multispectral satellite images are used very successfully for these purposes. They have an increasingly important and significant role in providing data on the studied territories, even in cases where no prior information about them is available.

**2. Briefly about the nature of multispectral satellite images and methods for extracting information from them**

In order to more clearly analyze some approaches for extracting information from multispectral satellite images, a series of experiments area made in the present paper. They used multi-zone photos taken with the Sentinel-2 satellite on March 15, 2023. and covering part of the territory of Portugal (located near the cities of Mérida and Évora) - fig. 1.

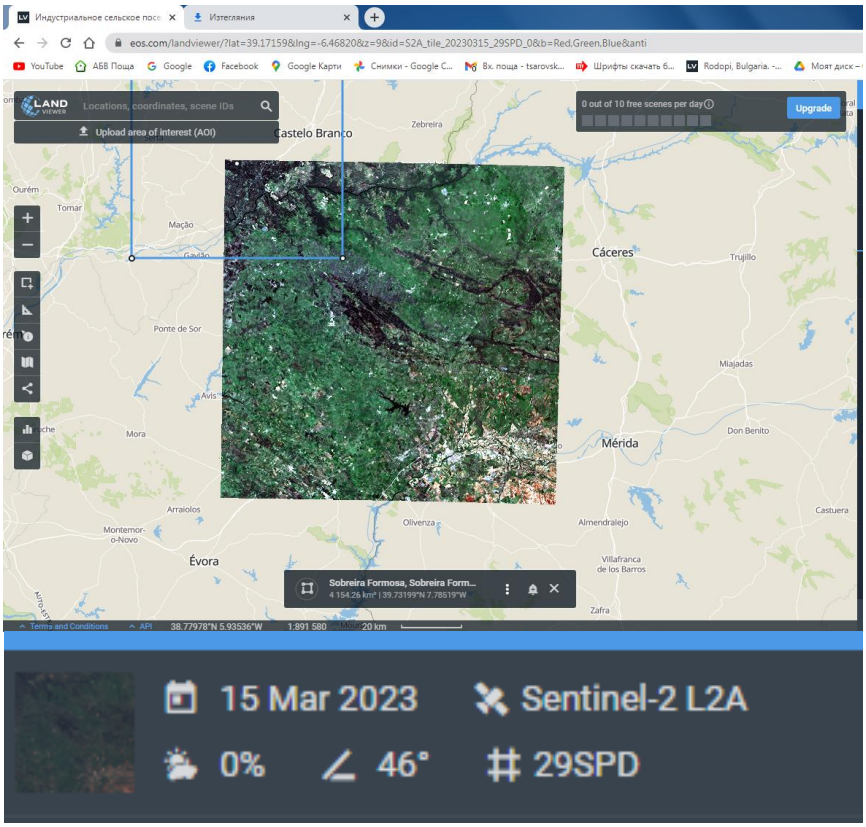


Fig. 1. Area of study in Portugal

By its nature, multispectral images represent a series (set) of photographs of the same part of the earth's surface, which were taken at the same time, but in several (most often about 10 in number) different spectral ranges [5]. Each individual photograph can be used independently as a valuable and convenient source of data for the area captured on it. In this case, processing is traditionally carried out by visual deciphering, where the quantity, quality and accuracy of the extracted information depends primarily on the experience and professional abilities of the specific RS specialist. But by using different computer methods much more can undoubtedly be achieved. This concerns both the increase in the quality and quantity of acquired information, as well as the achievement of significantly higher efficiency and improvement of working conditions. Therefore, several computational approaches to data mining are analyzed very

briefly below (due to the limited scope of the paper) and experimented with. For this purpose, the SNAP (Sentinel Applications Platform) software was used.

- **Creation of new composite images**

To enrich the extracted information and for the convenience of decoding, new synthesized color images can be created based on the output multispectral images. Most often, this is done by selecting three of the series of zonal photos, which are "colored" in red, green and blue colors and combined. In RS, two main options are used for synthesizing images - natural (Natural colors) reproduction of colors (red, green and blue range) and artificial (False color), in which images are created in pseudo-colors that are different from natural ones. New synthesized images (fig. 2 and fig. 3) were made for the studied territory from Portugal in two versions - Natural colors and False color. They are very valuable sources of data in RS. Their application for the study of plant cover is particularly indicative due to the peculiarities of the reflective characteristics of chlorophyll in the red and infrared regions of the spectrum.

Fig. 2. New image in Natural colors, 5.03. 2023, Sentinel 2A

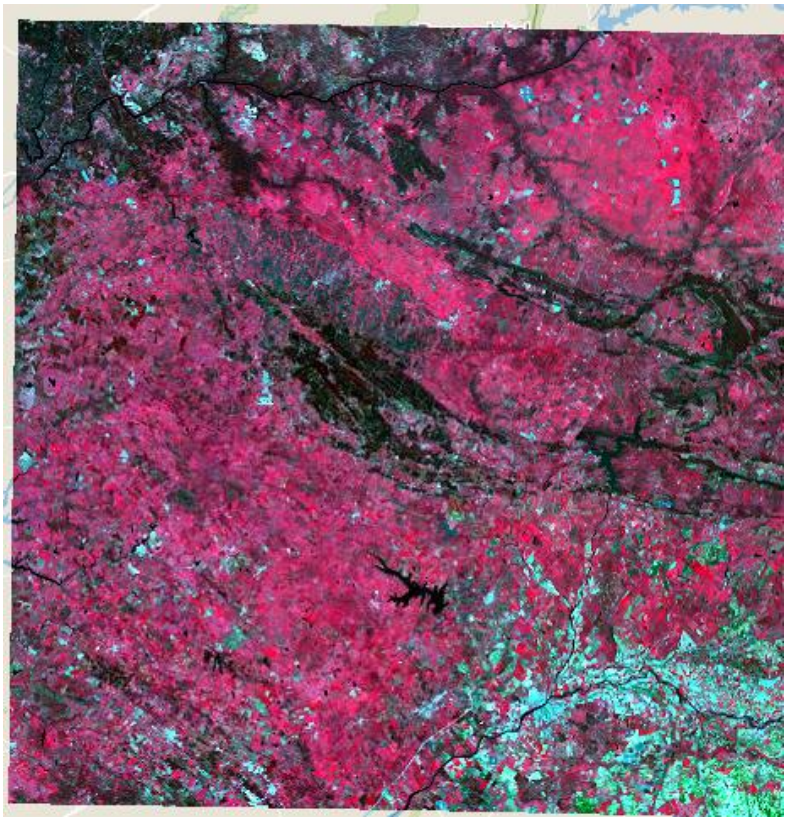

Fig. 3. New image in False colors, 15.03. 2023, Sentinel-2A

It should be emphasized that the joint deciphering and analysis of the vegetation based on the comparative analysis of the newly created synthesized images provides much richer and valuable information for its remote sensing compared to the use of individual photographs.

An objective prerequisite for this is the fact that vegetation has a low reflectivity in the visible range of EMC (only a small amount of green energy is not absorbed) and has a much higher reflectivity in the near infrared range. It is necessary to point out another important feature. Even those areas (vegetated) that appear homogenous on natural color images form differential zones on False color images in the infrared region (Fig. 2 and Fig. 3) because individual plants reflect EME in the near infrared energy by way too specific.

- **Spectral processing based on vegetation indices to create new indexed images**

A very important method for extracting data from multispectral satellite images are spectral transformations based on the use of different vegetation indices (VI), which the author has analyzed in detail in [1] and [2]. In fig. 4 the newly created Normalized Difference Vegetation Index (NDVI) and Soil Adjusted Vegetation Index (SAVI) indexed images of the study area from Portugal can be seen. They also show the color scales used to visualize the obtained areas corresponding to a specific interval of AI values. Indexed images

are a valuable tool for distinguishing areas occupied by vegetation, bare soil, urbanized areas, etc. [3] , as well as for diagnosing the condition of different plantations (including forests and agricultural crops [2]. According to the author, by distinguishing areas corresponding to specific intervals of VI values, in practice a kind of computer classification is carried out. For example, NDVI can take values in the interval (-1 to 1) and the higher it is its value for a specific area , the more healthy and lush the vegetation in it [2]. According to its visual qualities, the newly created indexed images can be considered as the result of performing a kind of classification of the studied territory, since the value of each pixel corresponds to a specific interval of VI values.

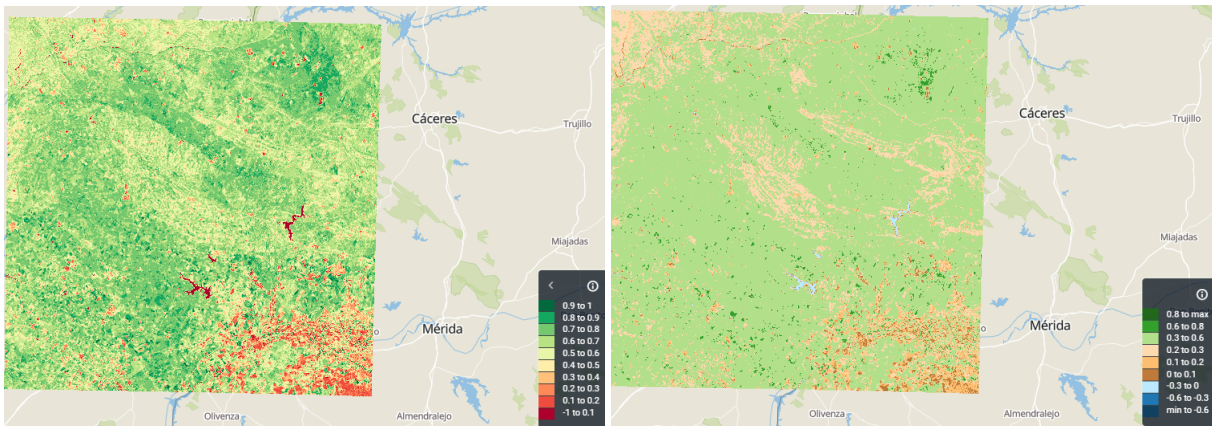


Fig. 3. NDVI and SAVI new indexed images, Sentinel 2A

- **Non supervised image classification**

For the studied territory, a pixel-oriented computer classification was made without training, using the ISODATA method. It is without an alternative in cases where no information is available about the studied parts of the earth's surface. It involves computer (machine) recognition and classification of the captured objects without the operator's intervention. After carrying out the uncontrolled classification of the studied territory from Portugal, recognition and interpretation of the created classes was done. They can be seen in fig. 5 The following colors were used for the respective object classes: pink - snow; light blue - cloudiness; white - high cloudiness; gray - medium cloudiness; blue - water areas; yellow - urban areas; brown - shadows from clouds. The experiment clearly proves that computer classification without training is a convenient and quickly applicable method.

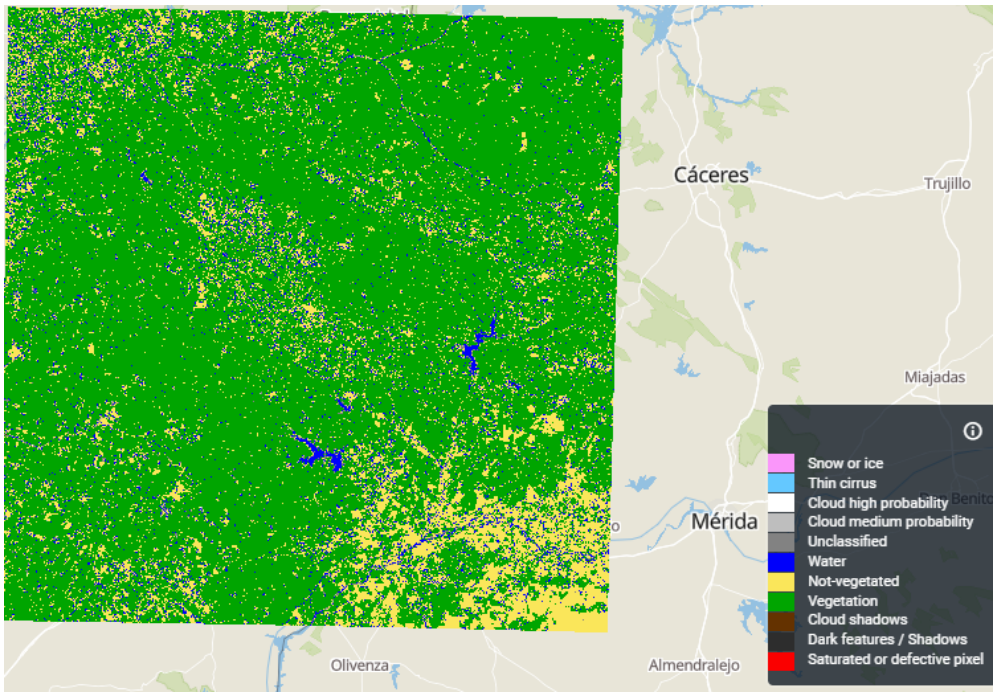


Fig. 5. Non supervised image classification from the input satellite image with its classes

## 4. Conclusion

From the performed brief analysis and experimentation of various methods for extracting data from multispectral satellite images, it can be concluded that they provide significant and convenient opportunities for relatively fast remote acquisition of rich and visual information (even in cases where there is no information about the studied localities). It could be used for many scientific and practical applications, such as for quickly establishing the actual state of specific territories (for management decisions, assessments, forecasts, etc.), for the creation of thematic maps, GIS layers, for the study of road objects [4], for the implementation of monitoring [5] (with a view to tracking the changes that have occurred) and many etc.

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