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ASPECTS REGARDING NDVI INDEX CALCULATED FOR SOFTWOOD AND MIXED STANDS

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Abstract: *Normalized Difference Vegetation Index represents an objective index of the stand's state of vegetation and is related to the quantity of biomass, vegetation covered percentage and the leaf area index. It is calculated differently, according to the satellite season, taking into account the spectral reflectance of the red band and that of the near infrared band. Obtaining NDVI index for the same area and on grounds of images taken over on different dates represents one of the manners of taking into evidence the changes occurred within the images taking over laps of time. The paper analyzes NDVI images obtained for U.P. Moieciului Valley, by processing two Landsat records, taken over on different times.*

Key words: *NDVI, satellite images, remote sensing.*

1. Introduction

The Normalized Difference Vegetation Index (NDVI) may be considered as a non-linear transformation of information content within red and near infrared bands of satellite records, at the same time representing a measure of the quantity and vegetation conditions [2]. This is in relationship to the features of the vegetation crowning, such as the biomass, Leaf Area Index (LAI) and vegetation covering percentage. NDVI is obtained from the following general relationship:

$$\text{NDVI} = \frac{IR - R}{IR + R}, \qquad (1)$$

where: R - spectral reflectance in the red band; IR - spectral reflectance in the near infrared band.

Its calculation is different according to the satellite season when satellite images were taken (Table 1).

The NDVI is a measure of the analysis of large surface of the vegetal carpet's richness. This index also allows identification of the water, snow and ice covered surfaces.

Values are within –1 and +1; the nearest to 0.5 and the highest one show the existence of a crowded vegetation and values below zero show its absence. For water, snow and ice the values of this index are below zero and for void soils, within 0 and 0.1 [6], [7].

The NDVI calculated on grounds of satellite records may be used in evaluating the spatial and time changes of vegetation. It is also preferred to simple indexes in global vegetation monitoring [3], [4]. More, NDVI data are useful in identifying ground categories having in view seasonal variations of vegetation [1], [5].

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Table 1

NDVI calculation in the cases of NOAA, SPOT, LANDSAT TM, ETM+ and TERRA MODIS images

Satellite senzor	Relation of calculation for NDVI	Wavelength [μm]	
		Red band	Infrared band
NOAA – AVHRR	$\frac{\text{band 2} - \text{band 1}}{\text{band 2} + \text{band 1}}$	0.54 – 0.68	0.73 – 1.10
SPOT	$\frac{\text{band 3} - \text{band 2}}{\text{band 3} + \text{band 2}}$	0.61 – 0.68	0.79 – 0.89
LANDSAT TM, ETM+	$\frac{\text{band 4} - \text{band 3}}{\text{band 4} + \text{band 3}}$	0.63 – 0.69	0.76 – 0.90
TERRA MODIS	$\frac{\text{band 1} - \text{band 2}}{\text{band 1} + \text{band 2}}$	0.62 – 0.67	0.841 – 0.876

2. Material and Methods

For the NVDI analysis two Landsat 5 TM and Landsat 7 ETM+ satellite image frameworks taken on August 18th, 1989, respectively September 9th, 2000 comprising also U.P. VI Moieciului Valley of O.S. Zărneşti were used (Figure 1). Frameworks are part of the satellite image having the 28th row, 183 orbits. Records were georeferenced in Universal Transverse Mercator system, WGS 84, by "the nearest neighbour" method. Their processing was made by the GRASS (Geographic Resources Analysis Support System) soft, rolling under Linux operating system.

The methods used were visual interpretation, analysis and comparison.

For easily identifying of the stand existing within the U.P. VI Moieciului Valley, basic planes comprising the forest stock were used, afterwards overlapped on the satellite images.

Fig. 1. *Localization of the research*

3. Results

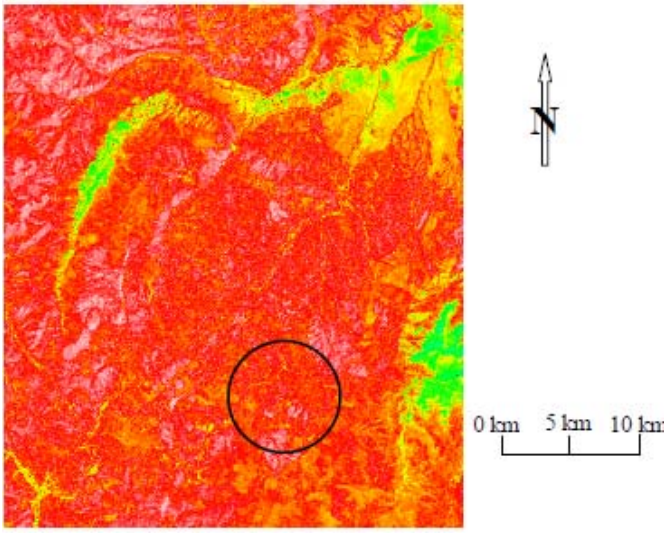
Images obtained after processing were presented in two manners. The first one, which allowed a less certain visual interpretation, reproduces vegetation in more red shades; the deeper red is vegetation is more dense and healthy, NDVI index presenting higher values (Figure 2).

The second manner provides a correct visual interpretation because the presentation manner is accompanied also by a legend, restoring the values of NDVI index, providing a security of the analysis (Figure 3). In this presentation manner, maximal values of the index are restored in dark green, representing a good state of vegetation, corresponding to deep red within the first presentation [8].

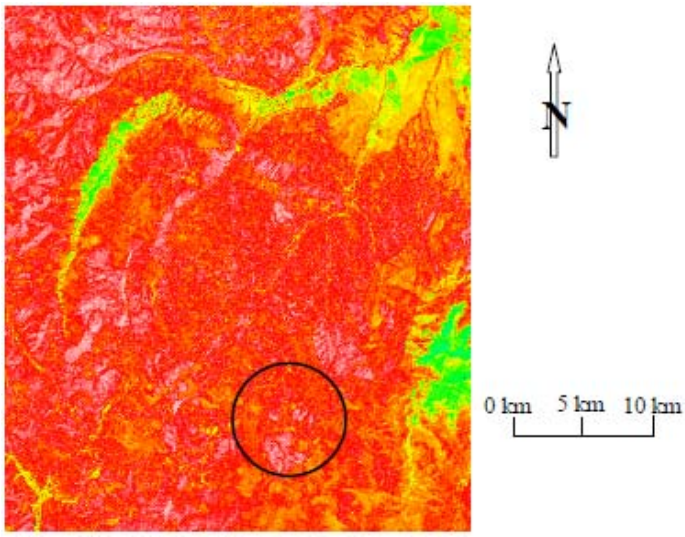
There were identified highest values of Normalized Difference Vegetation Index for the beech tree stand and the mixed one where beech tree is predominating. On both images, stands localized in Valea Lungă, being mixed stand show higher values of the index.

A special situation is found in the stand 122, which on the image from '89 is 121 years old and presented high values of the index.

Image taken in 2000 shows lower values of NDVI for this stand, a fact which could be explained by the partial progressive cuttings applied in 1995; for spectral answer recorded for the image beside young vegetation void soil took also part, thus leading to the appearance of the effect of soil background [8].

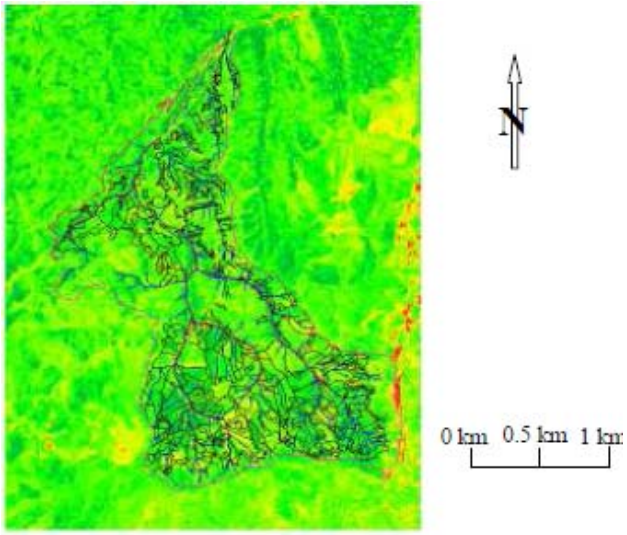


a)

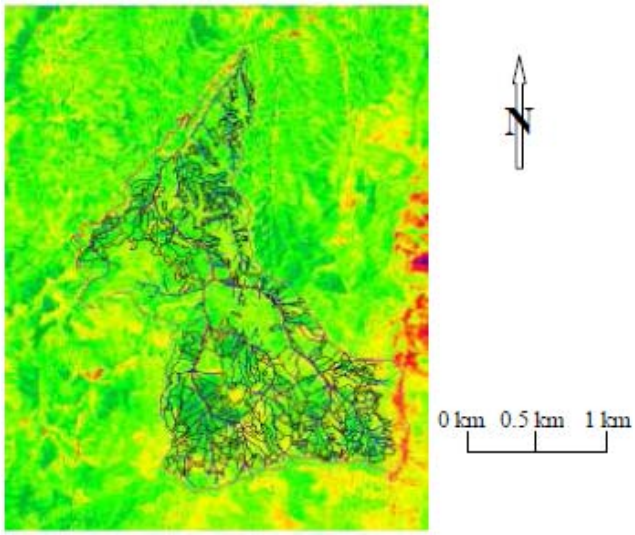


b)

Fig. 2. *Images obtained after having used NDVI normalized difference vegetation index for:*
a) Landsat 5 TM record of 1989; b) Landsat ETM+ record of 2000



a)



b)

Fig. 3. *Images obtained after having used NDVI normalized difference vegetation index:*
a) *Landsat 5 TM record of 1989; b*) *Landsat 7 ETM+ record of 2000*

The common spruce stand 103A, 102A and 101A, of ages within 110-135 years and those 87A, 87B (65 years and 20 years) present within both records a yellowish colour, representing a loose state of vegetation, stands being localized in the Lake Body. Such situations are also met by the stands 72A, 73 (65 years), 46A (115 years), 47C and those visible in 41B (90 years) - all these being localized within Băngăleasca valley. Stands 30A and 30B (130 years old common spruce) and partly

of 29A (110 years old beech tree) present also low NDVI values.

Analysis carried out also shows situations such as the common spruce and fir stand have NDVI values high enough.

Such a situation shown on both satellite images, may be met in 117A (25 years old common spruce), in 115, 94A (35 years old common spruce) and partly in 91A.

Generally, the stand of U.P. VI Moieciului Valley, appearing on the satellite image of 2000 shows a looser state of vegetation, than that of the record taken in 1989. Also as a general feature, the stand localized on the Popii Valley, Moiecelul Cald branch and that on the Moiecelul Rece, localized on the technical left mountainside (Găinii Rivulet) show the best state of vegetation which was found out on both Landsat satellite images.

The Clăbucetul de Jos and Clăbucetul de Sus pastures appear within the two records in a yellow colour, expressing a low NDVI value and hard vegetation conditions.

Void grounds, without vegetation, unproductive lands (rocky and stony regions) present on both records an NDVI value near to zero, appearing in more red shades. The same may be seen also in the case of clouded covers, where clouds appear in red and, here and there, even in violet towards black, representing negative values, within –0.3 and –0.6 on the NDVI scale [8].

Altitude may influence the NDVI index values. It has been found that the more altitude increases the more index is decreasing, mention being made on each image, not by comparing them. This fact may be accounted on the reliability of the forestry station's account, because the altitude stands generally have low efficiency, IV^{th} and V^{th} production classes, pointing out harder vegetation conditions.

There also may be pointed out the fact, that the stand located at the limit of alpine hole of the Băngăleasca Valley zoned within the 1C functional category, shows lower NDVI index values, also because of the fact, that the bandwidth representing this stand, is tightened very much here and there becoming only a few patterns of common spruce and stones and debris present within the area, contributing to the spectral answer [8].

4. Conclusions

In conclusion the NDVI index may be used, with good and best results, in featuring the state of vegetation of woods, generally on large areas.

Visual interpretation of images and analysis of the NDVI index's values, show that the stand appearing in yellow presents a poor state of vegetation, confirmed by the checking on the spot. It also is found that in the areas where green colour of the image is deeper, NDVI presents higher values, indicating a vigorous and healthy vegetation.

The more records taken in favourable atmospheric conditions and images corrected before using the index, the better the obtained results.

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