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Vegetative Index Perennial Dynamics Applied to the Cultivated Areas Vegetative Cover Analysis

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Abstract: Research results on NDVI vegetative index value assessment for the cultivated areas of Belgorod Region are presented. Index value analysis covers 15 years, starting year 2000. It has been established that NDVI absolute annual average values differ within region; such deviations could be caused by climate factors. The highest index annual average values are typical for north-western, most humid areas. The lowest index values appear in south-eastern part of the region. Long-term dynamics assessment for planted acreage growing winter crops and perennial grass has been performed based on vegetative index spring values.

Key terms: time-series, vegetative cover, perennial dynamics, planted acreage, NDVI.

1. Introduction

Developing the system of regional vegetative cover monitoring requires prior study of various characteristic, including remote sounding data. Planted acreage vegetation cover is characterized by high dynamics throughout the vegetation season, that is why the full view of its regional nature should be based on seasonal and perennial data analysis.

Currently new possibilities for dynamics research present themselves due to back file satellite acquisition stockpiling. Thus developing approaches to deciphering vegetation cover in order to make effective and timely cartographic images [1, 2] as well as developing new methods for parameter study are of great interest. One of the most promising branch is studying the investigative data on satellite footage for monitoring agricultural land types [6, 8]. The analysis of perennial vegetative indexes is of special interest, for it shows the phenological vegetation properties [9], useful for scientific and practical study.

Belgorod Region is highly developed agriculturally and has complex combination of various agricultural vegetation [10, 11], which makes studying seasonal and perennial growth dynamics a matter of immediate interest in the region.

The goal of the current research is analyzing vegetation cover of planted acreage on the basis of perennial vegetation index data (NDVI), having taken Belgorod Region for example.

2. Data and Research Techniques

The research was held on Belgorod Region territories, with their planted acreage over 1,5 million ga. Perennial dynamics assessment NDVI was held for the period of time covered by satellite footage MODIS, starting from the moment of satellite launching: that would make 15 years - from 2000 to 2014.

Applying geo-formation systems capacities (ArcGIS) mapping for planted acreage was held in Belgorod Region based on satellite footage data with high sampling resolution. For each planted acreage in Belgorod Region the NDVI vegetation index data has been calculated based on average MOD13Q1 [12] sampling resolution footage. NDVI data assessment was held for the 15-year long period with data implication every 16 days. Time-row statistical NDVI analysis was held using STATISTICA 10.0 program.

3. Results and Discussion

In the course of the research we have analyzed the number of perennial data on vegetation index for various regions in order to fathom the capabilities of NDVI implementation for discovering regional patterns depending on natural factors and specific ways of planted acreage exploitation. On the other hand, taking into consideration the connexity between vegetation index and growth bio-physical parameters, such as green bio-mass and plant cover, we have studied the capabilities of planted acreage exploitation assessment in different years.

Vegetation index analysis for the last 15 years showed that despite relevantly small acreage regional variations are present in NDVI data (Fig. 1).

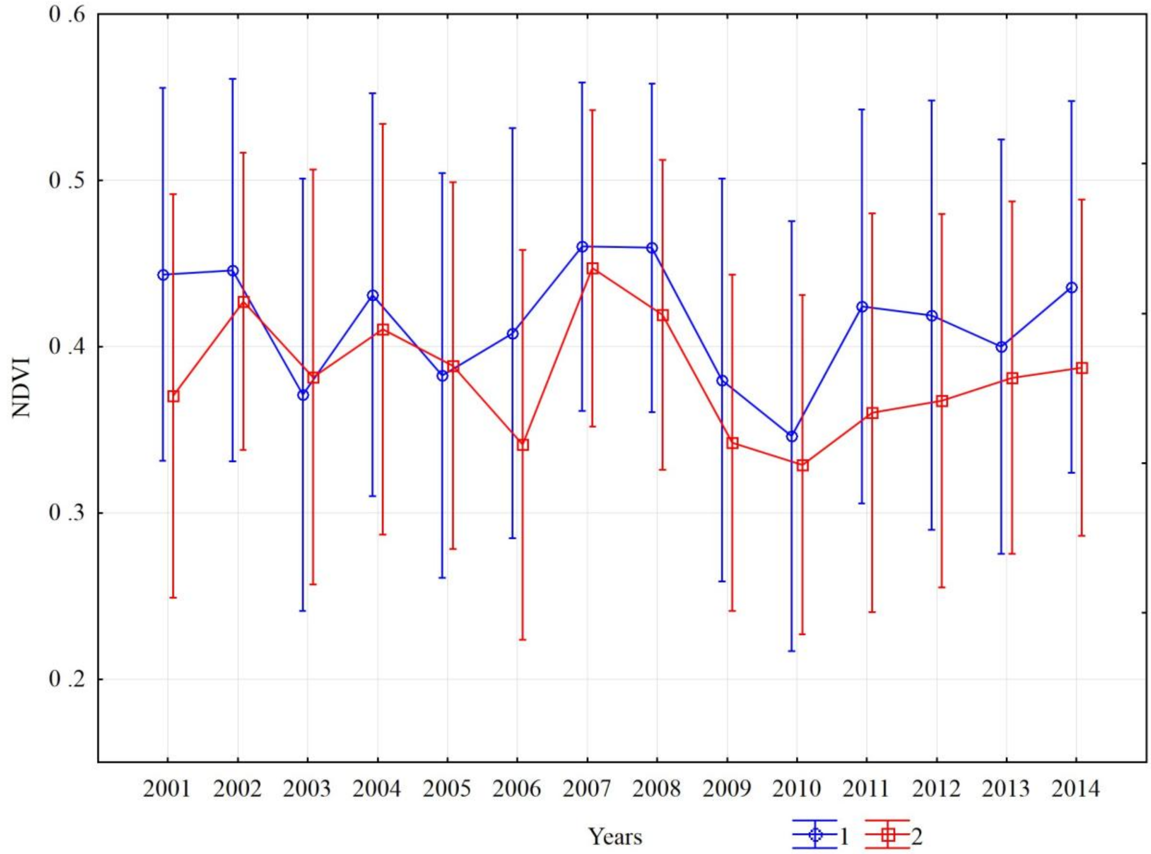

Figure 1: Perennial dynamics for the planted acreage annual average NDVI (including standard deviations) for north-western (1. Krasnoyaruzhsky Region) and south-eastern (2. Roven' Region) parts of Belgorod Region

Figure 1 shows that most of the analyzed period from 2001 to 2014 average annual vegetation index value for Belgorod Region north-western territories is slightly higher, then for the south-eastern ones. Statistical assessment by variance analysis confirmed variations of annual average NDVI values for the planted acreage in different region locations.

Regional NDVI index variations may occur due to growing different types of crops, as well as due to peculiar crop development during vegetation season - all of that makes indexes differ in green phyto-mass and plant cover values. North-western and south-eastern parts of Belgorod Region are geographically situated in different natural zones (wooded steppe and steppe) and different humidity conditions. Hydrothermic factor (showing humidity level) for the north-western region, is up to 1,2, while in south-eastern part it is barely 0,9. That is why different humidity levels may be the key factor influencing vegetation index regional values.

Green phyto-mass influence on vegetation index during particular times of

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vegetative season enabled us to analyze perennial acreage dynamics for several agriculture types. For example, in Belgorod Region in the beginning of April winter crop fields and perennial grass fields have higher vegetation index then other planted acreages [13], because only these agricultures actually grow during the period of time. That means that in April NDVI average for planted acreage is mostly made up of winter crop, perennial grass and bare acreage NDVI value. Respectively, we used perennial vegetative index dynamics for this period (Fig.2) to acquire data on winter crop and perennial grass acreage for the years 2000 through 2014.

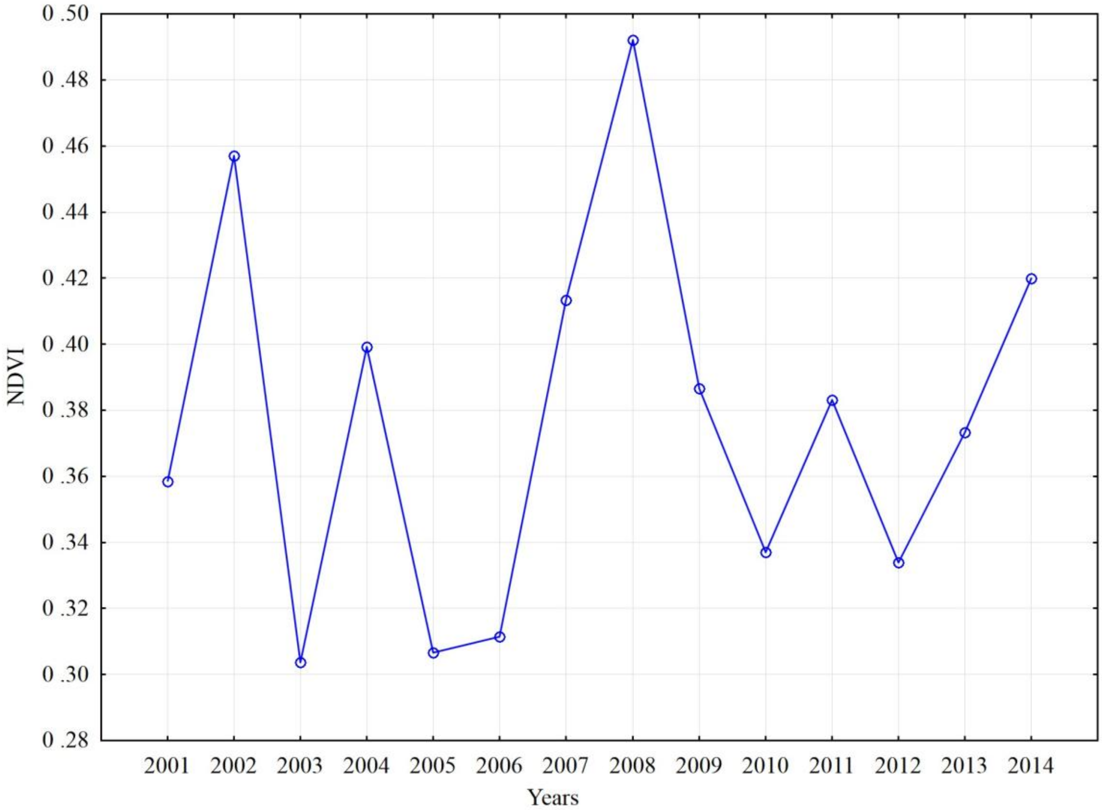

Figure 2: NDVI planted acreage dynamics for Belgorod Region April 7, 2001 - 2014

Still it is worth mentioning that in Belgorod Region winter crops acreage is several times bigger then that of perennial grass, meaning that NDVI index growing in April will mostly show winter crop acreage change in some years.

Having compared the result received with winter crops planted acreage data in the region [14], we've discovered general winter crop acreage enlargement, consistent with higher NDVI values in some years. For example, maximum acreage and gross collection for winter crops reached its highest value in 2008. This was the very year NDVI reached maximum value in the beginning of April. In 2001 winter crop acreage was vaster, the in 2010 and in 2012, which influenced vegetative index value as well.

4. Conclusion

Research on vegetative index value assessment NDVI for the cultivated areas of Belgorod Region was held. Perennial rows of annual index value for various region part were studied. It has been established that for most years during the 15-year long period, starting 2000, higher annual index values were common for north-western, more humid region part, rather then for dryer south-eastern part. Still, perennial dynamics of vegetation index value for various region parts has practically identical pattern.

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