The investigation of regional variations in biomass production for the area of the Danube-Tisza Interfluve using satellite image analysis

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SUMMARY

Quantitative as well as qualitative alterations in the vegetation cover are good indicators of environmental changes. The present paper discusses the problem of the dynamics of vegetation changes in response to short-term climatic changes via the application of remote sensing methods. According to the spatial and temporal analyses of AVHRR and MODIS satellites images for the determination of vegetation index (NDVI) for the area of the Danube-Tisza Interfluve, embedding a period of several decades, seasonal and trend-like dynamics seem to govern the alterations of the vegetation. The spatial analysis of the result gained may help us delineate the areas, which are potentially in danger of a presumed minor climate change.

KEYWORDS: remote sensing, NOAA AVHRR, Terra MODIS, NDVI, vegetation dynamics, climate change

INTRODUCTION

The regional effects of a presumed climate change within the area of Hungary mainly affect the areas of the Great Hungarian Plains, especially the regions of the SE Great Hungarian Plains and the Danube-Tisza Interfluve.

The vegetation cover may be a good indicator for such studies as climate can be regarded as one important factor playing a crucial role in the mobilization of biological energies and determining the actual rate of bioproduction.

The available data series in our analysis, embedding a period of 13 years between 1992 and 2004, does not enable the determination of the relationship between identified vegetation alterations and the possible climate changes. Can we identify important alterations besides the natural fluctuations?

MATERIALS AND METHODS APPLIED

Data analyzed

According to geographic analyses the landscape ecological value of the Danube-Tisza Interfluve is expected to decrease in the future (MEZŐSI et al, 1996) (Fig.1.). The signs of soil moisture quality and differences are well-observable – though at different rate – on the composition of woodlands with deep-rooted arboreal and shallow-rooted non-arboreal plants. Furthermore, woodlands tend to preserve precipitation quite well, thus can be regarded as good indicators of long-term droughts or dry periods[1]. Non-arboreal plants in general react more acutely to short

term droughts, since for them water supply comes mostly from precipitation. The primary goal was to observe natural water resources, thus large area irrigated agricultural regions do not fall into the area of analysis.

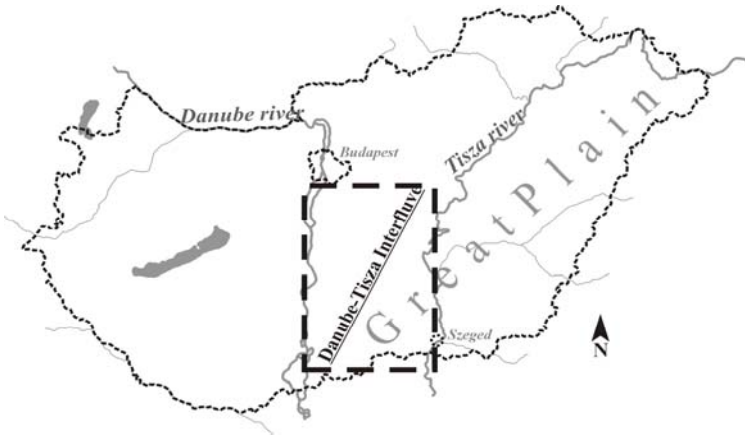

Figure 1. Location of study area (inside the frame)

The applied methods

Because of the great variability of land use in the Danube-Tisza Interfluve it was expedient to perform analysis of two land cover types close to natural conditions.

- The class *forests* consists of deciduous, coniferous and mixed woods with areas of 24,400 ha, 11,300 ha and 36,600 ha respectively.
- The class of *soft-stems* contains grasslands, meadows, pastures close to natural state with an area of 59,000 ha.

These categories were first analyzed individually then the outcomes were synthetized yielding the final results. The class of non-arboreal plants includes the entities of close-to-natural meadows, and pasturelands.

The most generally and frequently used method of predicting net biomass production via spectral analysis is the determination of the Normalized Vegetation Index (NDVI):

$$NDVI = (NIR - R) / (NIR + R)$$

where: R: the red value of the pixel analyzed, NIR: close to IR value of the pixel analyzed.

Via considering the distributions of precipitation, so-called average profiles were constructed for the individual classes analyzed on the basis of the average values of the wetter periods 1996-1999. The spatial and temporal analysis of alterations from these average profiles may be used for the determination of vegetation growth dynamics and supports delineation of areas threatened by permanent biomass-loss.

RESULTS

When evaluating the NDVI data the following factor had to be taken into account: in the period of 1992-1994 the consequences of a period with precipitation decrease beginning in the 1980's, whereas in the second half of the 1990's a phase of higher precipitation can be observed.

Immediate and delayed response of the vegetation to the changes in precipitation can also be observed when viewing the relation between precipitation and NDVI values.

When the alterations of the individual monthly values of a growth season are analyzed a negative trend could have been observed in the average NDVI data series f.i. primarily in the months of September (Fig. 2.). Mixed forests react especially strong to changes

SEPTEMBER

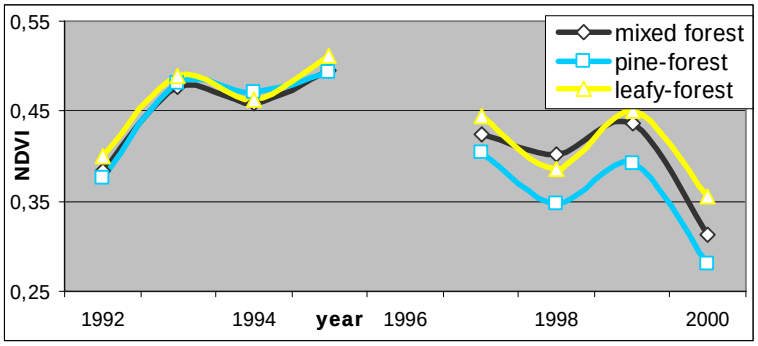

Figure 2. The monthly average NDVI values for the area of the Danube-Tisza Interfluve

The path as well as the relative position of the reference profile compared to one another meets the expectations concerning vegetation graphs related to different biomass amounts (Fig 3.). The most sensitive regions, regarding alterations in the environment are located in the central and southern regions of the area of the Danube-Tisza Interfluve with patches of sensitive areas present in the northern edges as well. Especially it is the mixed forest areas that react the most badly to environmental changes in a given period.

THE MOST IMPORTANT REMARKS OF THE ANALYSIS

The dominant character of precipitation change is generally well-observable in the vegetation. When looking at the annual values we can observe balanced conditions in the area under investigation, thus no general decreasing or increasing trends could have been found in this case. Changes in the biomass are most prominent in the woodlands. One can expect a decreasing activity in some months According to the results of several approaches, months can be regarded as a potentially imperiled month.

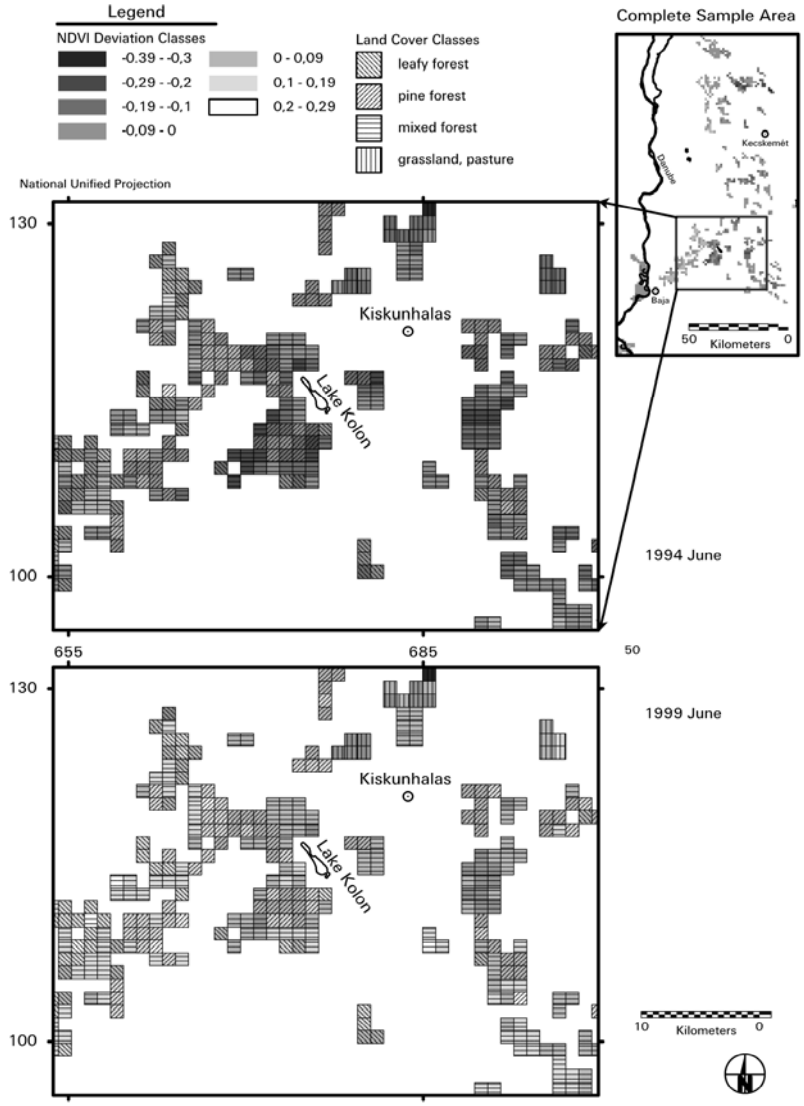

Figure 3. The regional distribution of NDVI differences for the area of the Danube-Tisza Interfluve

BIBLIOGRAPHY:

Eidenshink, J. C., Faundeen, J. L. H. (1996) 1-km AVHRR global land dataset: first stages in implementation. IJRS (http://edcdaac.usgs.gov/ 1KM/paper.html#science1)

Mezősi G., Keveiné Bárány I., Géczy R. (1996) The future ecological value of the Hungarian landscape. Acta Geographica Szegediensis, Tomus XXXV. pp.21-44.

Rakonczai J., Bódis K. (2001) A geoinformatika alkalmazása a környezeti változások kvantitatív értékelésében. In.: A földrajz eredményei az új évezred küszöbén. CDROM ISBN 963482544-3. p.15.

Szatmári, J. (2004) Evaluation of Wind Erosion Risk ont he Danube-Tisza Interfluve using the Revised Wind Erosion Equation (RWEQ). Acta Geographica Szegediensis, Tomus XXXVIII. pp.21-31.