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ESTIMATING THE IMPACT OF HUMAN ACTIVITIES ON THE ENVIRONMENT IN MOLDOVA REGION (HI INDEX)

Adrian Ursu[1], Vasile Jitariu, Alexandru Ciutea

Key words: anthropogenic impact, Human Impact Index, GIS, Moldova region

Abstract. This paper work tries to spatialize the effects of the anthropic activity on the environment, as the human society continuous development requires space , food, energy and resources and that has a significant impact . Trying to evidentiate this kind of pressure over the environment by cartographic materials, that combines all effects is an impossible endeavor , but highlighting affected areas in an irreversible manner by an increased degree of artificiality is a necessity for the future environmental policy, so, starting from this point we were able to apply a methodology on the studied area and we obtained a seth of conclusing results.

Introduction

This article aims to map out the impact of human activity in the region of Moldova-Romania . In order to realize the HII (Human Influence Index) we used a series of parameters like: Population Density, Railroads, Major Roads, Nighttime Stable Lights Values, Urban Polygons, Land Cover Categories (urban areas, irrigated agriculture, rain-fed agriculture etc.), but in our study we focused on the direct measures of human infrastructure and population that have the most immediate impact on wildlife and wild lands and for which geographic data were readily available. Although they have important consequences for terrestrial ecosystems, effects of pollution, global warming, increased exposure to ultraviolet radiation, and other global phenomena, are not included in this study. We were able to determine the degree of anthropic footprint or the level of intensity of disturbing influence in the natural landscape by monitoring the effect of anthropogenic stressors and quantifying the amount of stress within our studied area, thing that brought out also a stock of information about environmental quality and the way its being conserved.

The results shows that in Moldova the highest values in HII are in the regions with low altitudes, flat areas , and the less affected natural ecosystems are usually in the high mountain areas or upper hilly regions situated especially in the west of the region where the natural landscape inputs a larger number of restriction in anthropogenic activities.

The studied region, Moldova, represents the territory located in the ENE part of Romania and is divided geomorphologically into two subunits: the mountain area (the western frame) and the hilly regions and plains in the central and eastern parts to the Prut River.

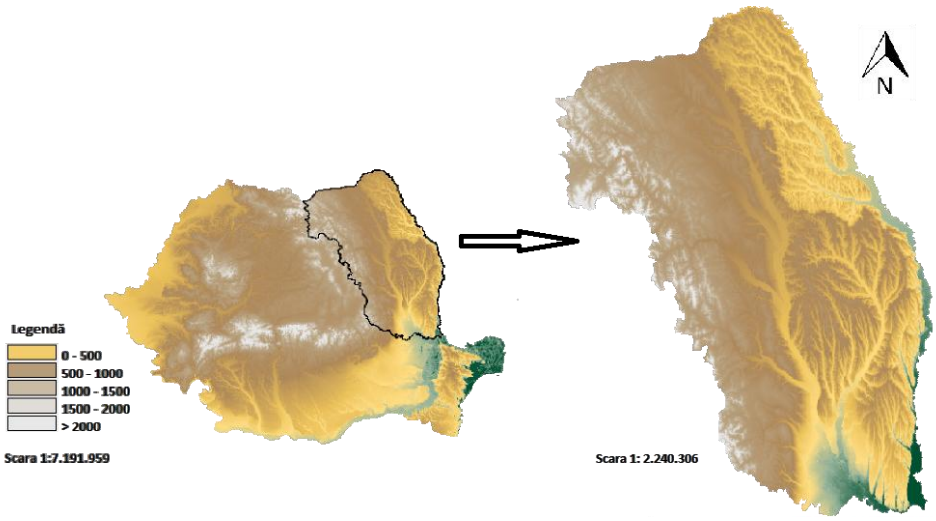

Fig. 1 Location of the study area

Materials and methods

In order to map the anthropic impact on the natural landscape, a series of steps have to be taken to highlight on a realistic scale the pressure exerted by the HII parameters on the environment. The parameters (human density, roads, railoads, nighttime stable lights, urban polygons, land cover categories and the coastline, but not in our case) used in this study have recieved grades, according to various methodologies from the literature, methodologies that were modified in order to obtain more detailed information.

Thus, for human settlements (urban / rural), there were given two classes, respectively 0 for the areas outside the settlements and 10 for the urban areas, which were directly related to the population preasure exerted on the wildlife and which was calculated by the density of the population(population / km2) for urban areas. After this step the results recieved values from 0 to 10, the high values corresponding to cities with relatively high pollutant density.

For the roads impact on the environment we resorted to a vector file with the road network, over which a Sanderson classification has been applied and has resulted in a credit rating of the type: within 2 km of roads-8, within 2 to 15 km of roads- 4, beyond 15 km of roads-0. In the same way, we also worked to observe the impact of the railways on the environment, the awarding of two classes: within 2 km of rairoads-8 and beyond of 2 km of rairoads-0.

The land cover categories were taken from Corine Land Cover 2010 data set and then them were classified in 7 categories (with different impact over the environment.

Night-time lights provide a versatile and user friendly data source for the social scientist, whether it is used simply to define an urban area or used more intensively to model population, economic activity or some other socio-economic parameter. In this paper , it was used the Version 4 Defense Meteorological Satellite Program Optical Linescan System (DMSP-OLS) Nighttime Lights Time Series data , available from the National Oceanic and Atmospheric Administration's (NOAA) National Geophysical Data Center (NGDC).

Visible and infrared imagery from DMSP Operational Linescan System (OLS) instruments are used to monitor the global distribution of clouds and cloud top temperatures twice each day

The archive data set consists of low resolution global and high resolution regional, imagery recorded along a 3,000 km scan

Onboard calibration is performed during each scan. Visible pixels are relative values ranging from 0 to 63 rather than absolute values in Watts per m^2. (http://www.ospo.noaa.gov/). We reclassified this raster image into 4 classes in order to obtain a more omogene and clear image about how this parameter affects the environment.

Results and discussions

Regarding the impact of the roads on the natural landscape we mention that they are more intense, as we expect, on the nearby areas, highlighting a higher density of the road network in the central and then eastern part of Moldova due to the favorable nature of the natural conditions, but also the presence of a significant number of localities, compared to the western part. In the same way, the impact of the railways on the environment is manifested. Two main arteries on the northern-southern direction, which are connected by a series of transverse railways, forming railway nodes in the Suceava, Pascani, Iasi, etc., are distinguished.

The areas least affected by these parameters are those located in the western part of the mountain area and parts of the Central Moldavian Plateau due to the presence of a high energy relief that does not allow the development of dense road or rairoad networks and the presence of some areas occupied by forest.

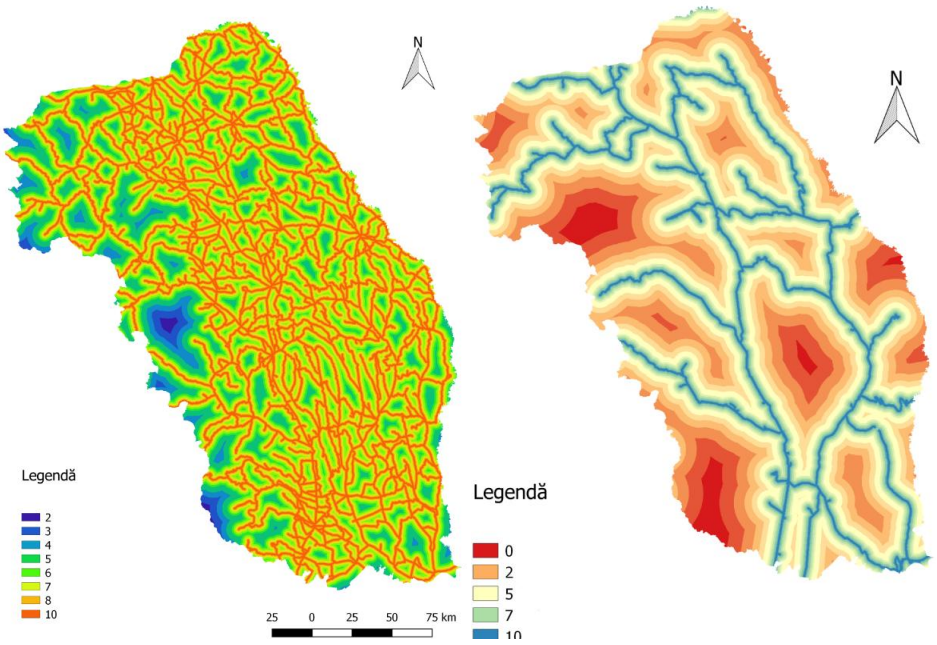

Fig. 2 Roads and railoads preassure

The land use in Sanderson's methodology was structured in three categories so that the greatest environmental pressure is exerted by the localities and their adjacent areas, including green areas for relaxation, industrial and commercial areas, etc., followed by of the agricultural and fruit-growing areas, the lowest human pressure being present in the forest-related areas. In this case, HII seems to be concentric disposed so that the highest values are present on the territory of the localities, and as we depart from these "hot spots" the values tend to decrease, but in the present study the land use impact over the environment was divided in 7 classes. An obvious fact in western Moldova is that a relatively low human pressure appears to extend across the north-south strip, as expected in the mountain

area, while in the rest of Moldova there is a higher human anthropic pressure, except for three areas belonging to the Hill Mare Harlau, the Central Moldavian Plain and the Prut Meadow.

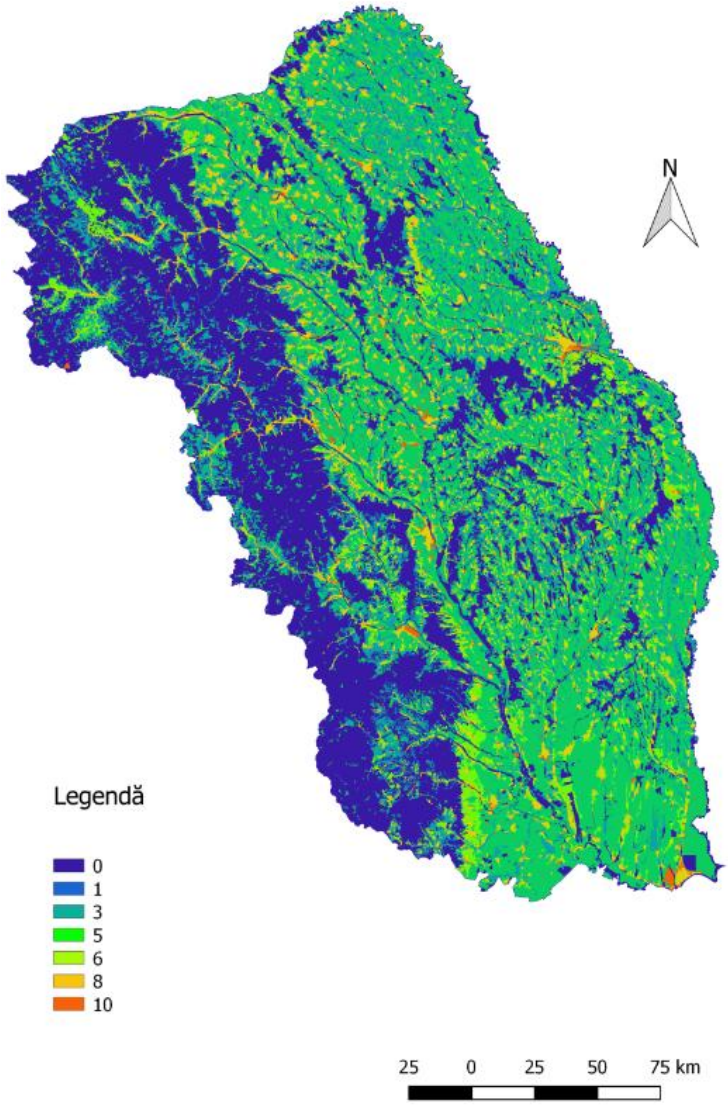

Fig.3 The land use impact

Knowing nighttime stable lights as an environmental pressure factor, we managed to download a raster file using DMSP night-time data to provide nighttime stable light values based on pixel brightness, and in this way we could perform a mapping of this parameter showing that the highest values are in the central area, on a north-south direction, then in the eastern area, and the lowest values are present on the western frame as a result of a networks of low density localities

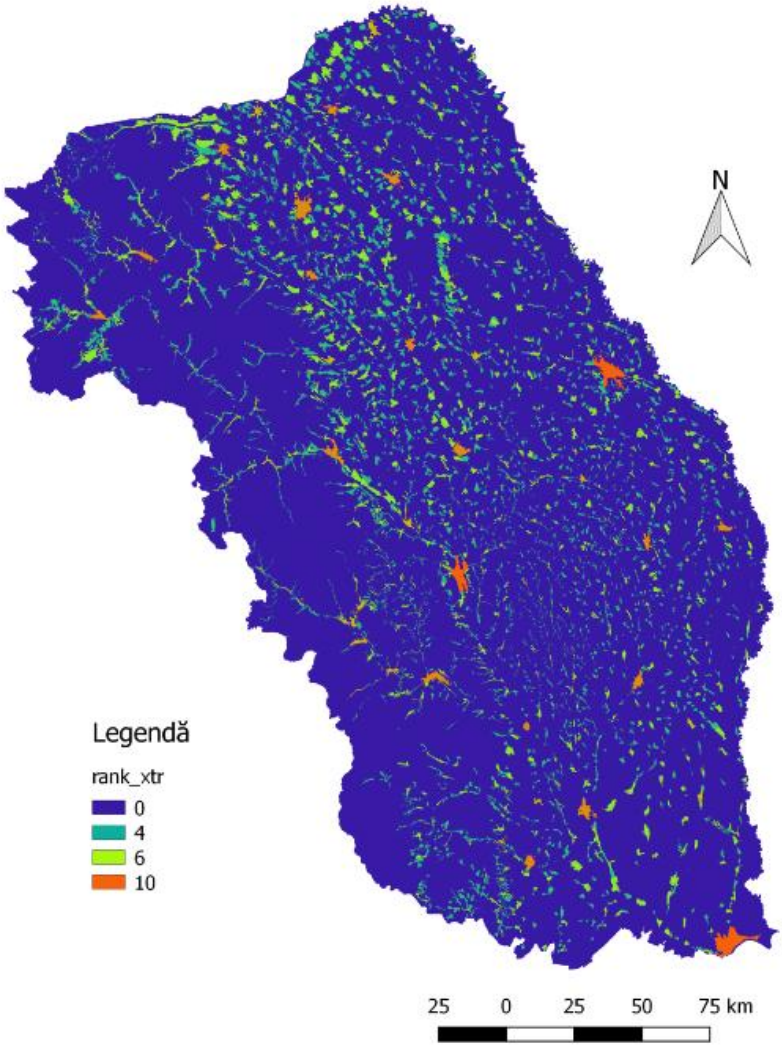

Fig. 4 The nighttime stable lights impact

Population density was calculated for intravilan territories, so it is in direct relation to urban and rural localities. As expected, the highest population density values are in the big cities , but also in various smaller towns, and then the rural areas are characterized by a lower population density, but on a wider area. Population density appears to be more pronounced in the northern central part of Moldova due to a large number of localities located in that region and due to the presence of relatively large cities: Iasi, Bacau, Suceava, Botosani etc, while in the mountainous area (the western part), this parameter, does not put considerable pressure on the environment.

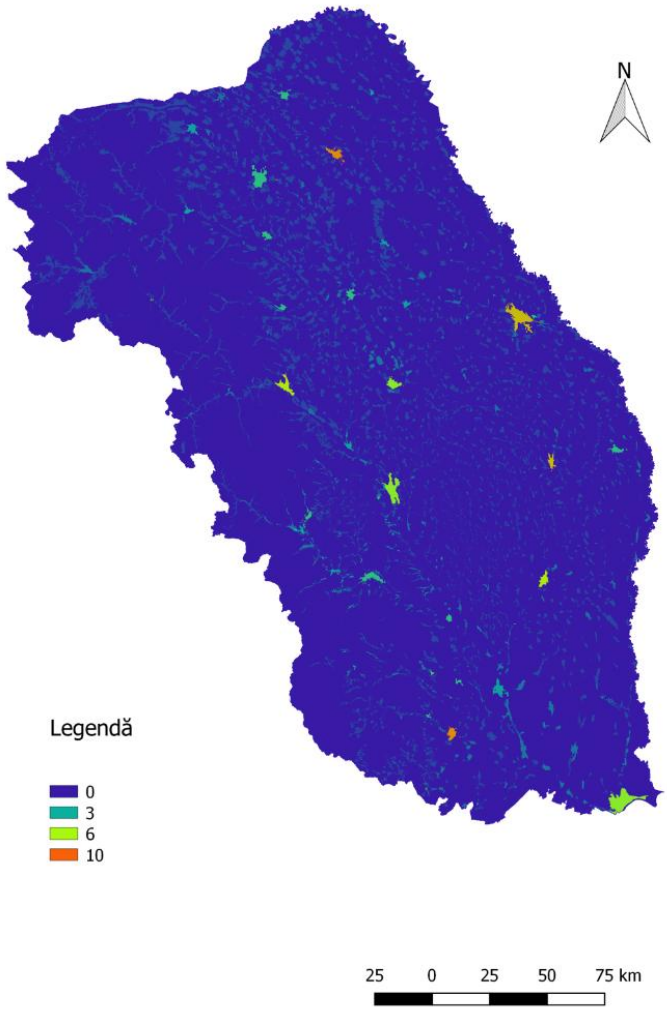

Fig. 5 The population density impact

By overlapping the factors mentioned above we were able to map the Human influence index and how the human pressure is distributed in the territory so that the highest values of human pressure will be located in areas where HII parameters with the largest values will intersect, and the smallest values will be identified in areas where the HII factors shows low or even null values. Hot spots, where human influence is very high, are located in urban settlements that have a significant impact on the environment, which gradually decreases with increasing distance from them and access ways. The western part of Moldova seems to be least affected by anthropogenic activities, the values of pressure being small or even null in very restricted areas. We also identify two low impact islands on the natural landscape in the Harlau High Hill area and the Central Moldavian Plain as a result of this forest.

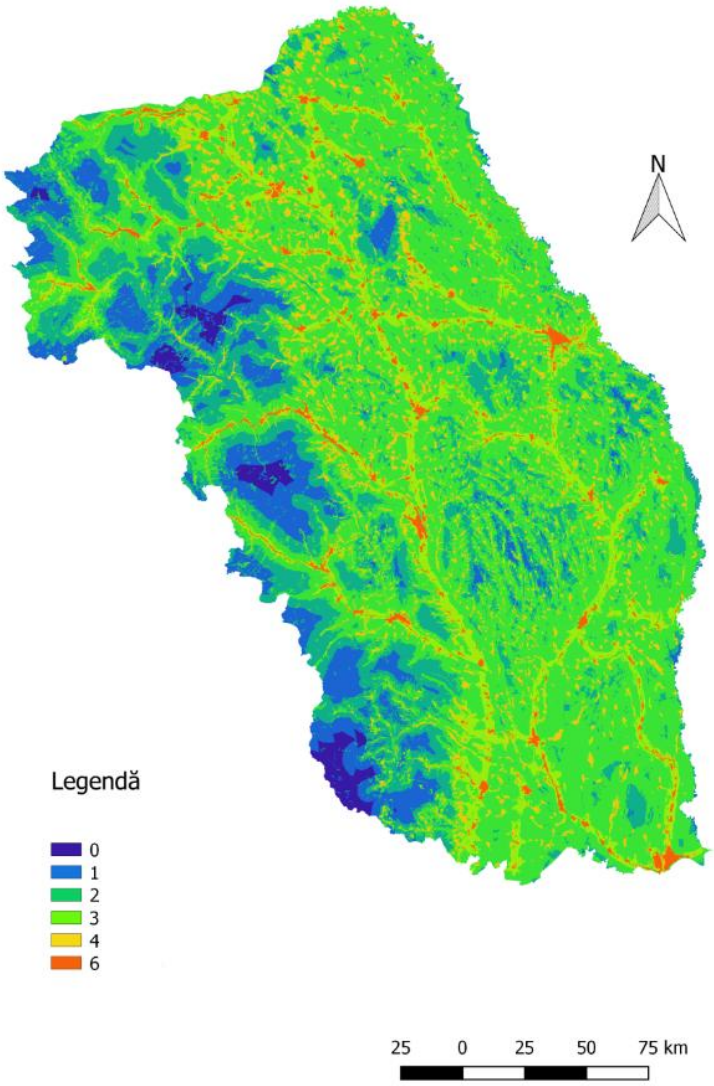

Fig. 6 The human influence index impact

Finally, after the cumulating the parameters presented above and obtaining the final result, we overlaped it over the protected areas from the studied teritory.

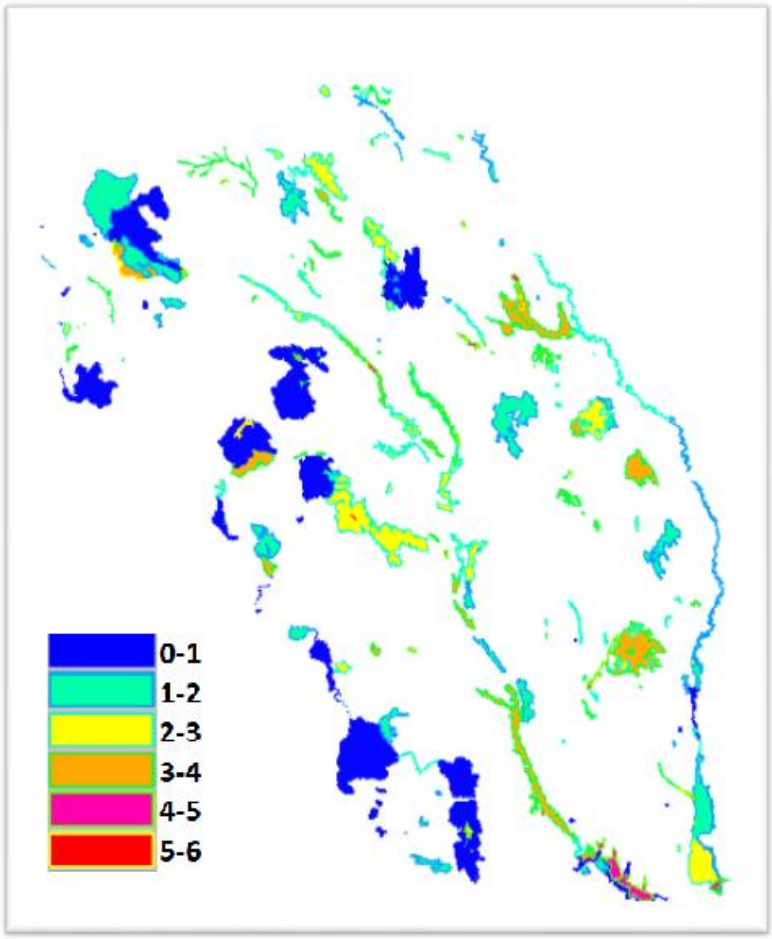

Fig. 7 The HII over the protected areas

Conclusions

The result of our study is a conclusive one that offers a clear view of the field situation and an accessible way of interpretation and deduction to a wide audience, but which can be considered a global one, fact that has led us to make a series of changes to the used methodology, so that the final results are more detailed and closer to reality.

Changes have been made to land use, which in the first phase has been classified into three categories, and now it has been changed into 7 classes, with different values for urban areas, industrial areas, shopping areas, leisure / relaxation areas, etc. as well as the areas belonging to the agricultural field, depending on the anthropization levels (irrigated / non-irrigated, primary / secondary pastures etc.).

In the case of communication networks (roads and railways), the changes were made on the way of classifying the impact of these on the environment, revealing the same pattern in which the western part of Moldova suffers from a much lower anthropization stage compared to the rest of the studied territory, but after that we have to mention the spatial restraint of the low-impact areas, which is brought to a scale as close as possible to reality.

References

1. **http://www.ospo.noaa.gov**
2. **http://www.tradingeconomics.com**
3. **http://pegasosdi.uab.es**
4. **Global Human Influence Index (Geographic), v2 (1995–2004)**
5. **Christopher N.H. Doll, CIESIN Thematic Guide to Night-time Light Remote Sensing and its Applications, 2008, Palisades, NY, USA.**
6. C. Ion, C. C. Stoleriu , E.Baltag, C.Mânzu, **A. Ursu**, A. E. Ignat (2011)The birds and habitats in wetlands Moldova, Publisher University "Alexandru Ioan Cuza", 290 pp., ISBN 978-973-640-660-7
7. Mihai Bulai, **A. Ursu** (**2012**) **-Creating, Testing And Applying A GIS Road Travel Cost Model For Romania** - Geographia technica nr.1.2012 ISSN 2065-4421
8. **Ursu A.**, Sfîcă L., Niacșu L., Minea I., Vasiliniuc I., Stângă I. C. **(2007) The changes occured in the land use from the eastern part of Romania after 1989 – remote sensing and GIS application**, Present Environment and Sustainable Development, vol. 1, Ed. Universităţii „Al. I. Cuza" Iasi, pp. 313-320, ISSN 1843-5971
9. **Ursu Adrian**, Oana Andreea Ungureanu, Vasilică Istrate,Anca Acuculitei, Andreea Buciumanu **(2015)** – **The forest area changes in the Prut river watershed (Romania)**, 15th International Multidisciplinary Scientific GeoConference SGEM **2015**, Conference Proceedings -Informatics, geoinformatics and remote sensing, pp. 1131 – 1138, ISBN 978¬619¬7105¬35¬3, ISSN 1314¬2704.
10. **Ursu Adrian**, Raluca Burtila, Vlad Minea, Andrei Marius, Pavel Ichim **(2015)** – **Urban public transportation system changes, in post communist period in Iași municipality**, 15th International Multidisciplinary Scientific GeoConference SGEM **2015**, Conference Proceedings -Nano, Bio and Green Technologies for Sustainable Future, pp. 615–621, ISBN 978¬619¬7105¬43¬8, ISSN 1314¬2704.