REMOTE SENSING BASED ANALYSIS OF LAND COVER DYNAMICS IN THE POLESIE STATE RADIOECOLOGICAL RESERVE

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Commission IV, WG IV-2

KEYWORDS: automated land cover interpretation, protected areas (SPNA), geosystem dynamics.

ABSTRACT
Automated analysis (radiometric and atmospheric corrections, supervised and unsupervised classifications) of Landsat imagery was conducted. The current structure and land cover dynamics of Polesie SRR is considered in the paper. A thematic map of lands within the reserve territory was created.

1. INTRODUCTION

Global satellite data obtained from Landsat satellite system was used for geographical research on highly protected natural reserves. This also makes possible detection and estimation of changes taking place there. Advanced satellite technologies help to improve the quality of the object recognition and classification. They are also intended for analysis of natural ecosystems within vast territories (Labutina et al. 2011).

Polesie State Radioecological Reserve (PSRR) is very important area for the investigation of the modern natural landscape structure and geosystems of Belarus. The Reserve lies in south-eastern part of Belarus and occupies 216 800 hectares (it is the largest natural reserve in the country). This unique territory is not affected by the man-caused load, thus it can be treated as a reserve intended for protection of the Polesie region biodiversity in Belarus and Europe. The Reserve was created in 1988 after the Chernobyl nuclear disaster with the purpose of monitoring changes taking place in the Zone of Alienation.

2. BACKGROUND STUDIES

In addition to radiation-related problems the Reserve is facing quite a number of other problems. Land use and land cover is a very important aspect of national strategies for managing natural resources and monitoring environmental changes. Evolution processes occurring in reserve landscapes lead to serious biological and geographical changes. The reserve monitoring system created in Belarus does not meet current requirements for the efficiency and accuracy of information (Sipach et al. 2009). At the same time traditional techniques of field investigation require a lot of time and financial costs. The Reserve has a vast territory with large forest areas and almost impassable marshes. Today the area is unpopulated and has a high level of radiation.

The most informative method for land dynamics study is mapping. The most suitable solution of this problem is the application of advanced geospatial techniques of remote sensing analysis and GIS methods of digital mapping (Prakasam 2010).

3. METHODOLOGY OF AUTOMATED LAND DYNAMICS RECOGNITION

In this study were used Landsat- 5 TM (date 31. 05.1986) and Landsat -8 (date 31.07.2014) images. These data sets were imported in satellite image processing software ERDAS IMAGINE version 9.3 (Leica Geosystems, Atlanta, U.S.A.).

The main step during pre-processing was the atmospheric correction. For this purposes was used the module ATCOR (the module for computing a ground reflectance image for the reflective spectral bands, and emissivity images for the thermal bands).

Then image classification procedure is used for classification of multispectral pixels into different land cover classes. In order to find the optimal number of land classes unsupervised classification was carried out. Thereafter several testing sites (for each land class) were created. Such testing sites are areas that represent each known land type that appear fairly homogeneous on the image (as determined by similarity in spectral values). They were located and circumscribed with polygonal boundaries drawn on the image. For pixel clustering the maximum likelihood algorithm of supervised classification was used.

Algorithm based image classification techniques used for digital change detection in land cover classes gave good results. The overall digital classification was found to be satisfactory. The accuracy assessment results were obtained about 89.22 percent of overall and 0.7783 Kappa accuracy for the year 1986 while the accuracy for the year 2014 image was found about 87.72 percent overall and 0.7633 Kappa.

As a result of automated recognition six land cover classes were mapped in the Polesie State Radioecological Reserve, in particular: water areas, forest areas, thin forests, areas covered in trees and bushes, bottomland meadows and agricultural lands. In addition, the new class - wetland areas - was outlined on the images of 2014.

The classified layers were compared with Google earth high resolution images and error matrix was prepared. Mapping and analysis of land cover classes were performed in ArcGIS 9.1 software. The land cover maps obtained from image classification shown in Fig. 1, 2 for the year 1986 and 2014 respectively.
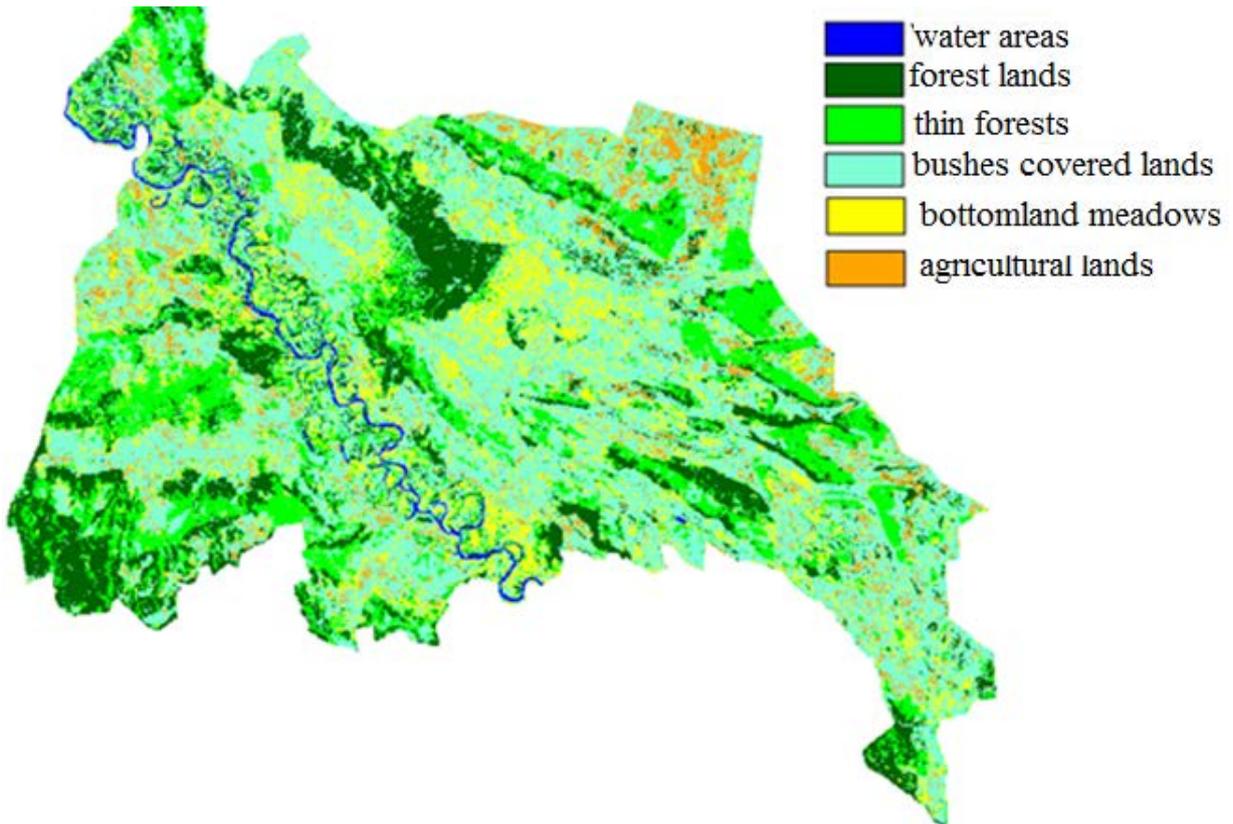
Figure 1: Map of spatial structure of land cover in 1986 (based on remote sensing, Landsat 5 TM)
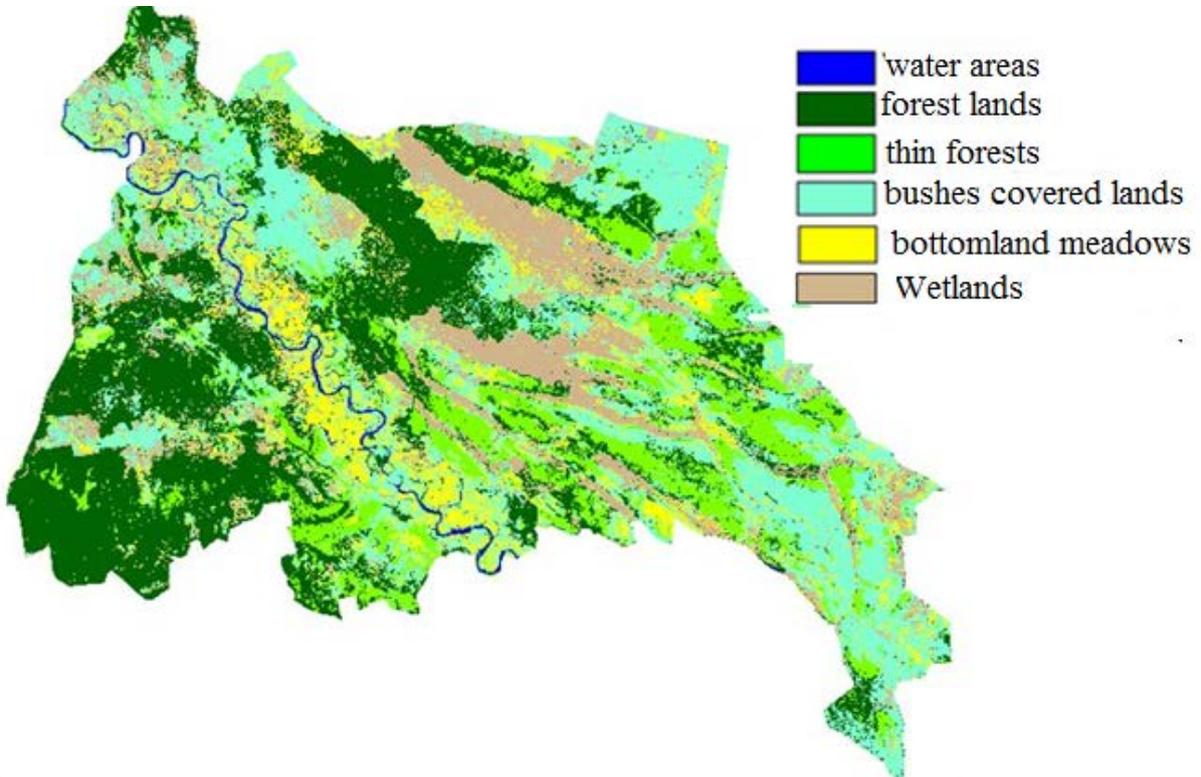

Figure 2: Map of spatial structure of land cover in 2014 (based on remote sensing, Landsat 8)

The analysis of images has led to the conclusion that during the 28 years of the existence of the Reserve large changes have occurred in the land structure. The

dominant changes which occurred in the study area are the croplands dissolution. Agriculture areas degrade persistently. The forest area on the contrary has increased significantly. By the reason of reclamation systems degradation the repetitive eutrophication and areal saturation is developed. The traditional use of bottomland meadows for haying and grazing was stopped. This has caused the meadows' bushing.

4. CONCLUSION

In current research 788 we carried out mapping of different land cover types and their change detection using digital image processing techniques. The spatial pattern and land cover change detection can be successfully used in biodiversity conservation and environmental development. The study of structure and dynamics of land areas in the Polesie State Radioecological Reserve will allow foreseeing the nature of future changes and undertake all necessary measures to prevent further losses during the highly dangerous occurrences (e.g. fires). Integration of GIS-technologies with remote sensing allow developing strategies to improve the efficiency of undertaken economic, environmental and monitoring measures.

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