Deforestation Monitoring Using the Aerospace Imaging Systems Data and ENVI Software

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Abstract – T**he deforestation problem and approaches to its solution are considered. The possibility of using the aerospace imaging systems data and ENVI software to build a system for deforestation monitoring are investigated.**

Keywords – **deforestation, aerospace imaging systems, ENVI software.**

I. INTRODUCTION

Deforestation is the removal of a forest or stand of trees where the land is thereafter converted to a nonforest use.

Deforestation occurs for many reasons: trees or derived charcoal are used as, or sold, for fuel or as timber, while cleared land is used as pasture for livestock, plantations of commodities, and settlements. The removal of trees without sufficient reforestation has resulted in damage to habitat, biodiversity loss and aridity. It has adverse impacts on biosequestration of atmospheric carbon dioxide. Deforested regions typically incur significant adverse soil erosion and frequently degrade into wasteland.

There are many causes of contemporary deforestation, including corruption of government institutions, the inequitable distribution of wealth and power, population growth and overpopulation, and urbanization. Globalization is often viewed as another root cause of deforestation, though there are cases in which the impacts of globalization have promoted localized forest recovery.

II. DEFORESTATION PROBLEM

In connection with the aggravation of environmental problems like unsustainable natural forest management in recent years have seen considerable interest in forest monitoring [1–4].

There are set of environmental problems:

- **Atmospheric**. Deforestation is ongoing and is shaping climate and geography. Deforestation is a contributor to global warming, and is often cited as one of the major causes of the enhanced greenhouse effect. Forests are also able to extract carbon dioxide and pollutants from the air, thus contributing to biosphere stability.
- **Hydrological**. The water cycle is also affected by deforestation. Trees extract groundwater through their roots and release it into the atmosphere. When part of a forest is removed, the trees no longer evaporate away this water, resulting in a much drier climate. Tropical rainforests produce about 30% of our planet's fresh water.
- **Soil**. Undisturbed forests have a very low rate of soil loss, approximately 2 metric tons per square kilometer (6 short tons per square mile). Deforestation generally increases rates of soil erosion, by increasing the amount of runoff and reducing the protection of the soil from tree litter.
- **Ecological**. Deforestation results in declines in biodiversity. The removal or destruction of areas of forest cover has resulted in a degraded environment with reduced biodiversity. Forests support biodiversity, providing habitat for wildlife; moreover, forests foster medicinal conservation.

To control deforestation process are used such approaches: *reducing emissions*, *farming*, *forest management*, *reforestation*, *forest plantations*, *monitoring deforestation*.

Reducing and monitoring deforestation is a new chapter of this dense keywords lifetime. There are multiple methods that are appropriate and reliable for monitoring deforestation. One method is the "visual interpretation of aerial photos or satellite imagery that is labor-intensive but does not require high-level training in computer image processing or extensive computational resources". Another method includes hot-spot analysis (i.e. locations of rapid change) using expert opinion or coarse resolution satellite data to identify locations for detailed digital analysis with high resolution satellite images.

The main steps of monitoring forest use of space information are:

- aerospace information preparation and preliminary processing;
- collection and accumulation of ground-based information on forestry characteristics;
- co-processing of aerospace and ground-based information;
- analysis of the results and predict the state of forests, particularly the forestry activities effects.

III. AEROSPACE IMAGING SYSTEMS

One of the topographic system problem in Ukraine is the information aging on topographic maps. About 70 percent of topographic maps and plans all sizes have created more than 10 years ago, and its relevance and information content they do not meet modern needs. This applies to topographic, thematic and special mapping. Therefore, the updated basic cartographic materials (maps, plans) is priority in mapping Ukraine [5–7].

Modern space-based systems, in particular, Ikonos, Quick Bird, will obtain images with a linear resolution of the terrain 0,6-1 m, which corresponds exactly map (plan) 1:5000 scale.

Space system image discernment examples are given in Table 1 [8].

TABLE 1

SPACE IMAGE DISCERNMENT

Space system	Country	Orbital height, km	Discern-ment, m
Quick Bird-2	USA	450	0.6-2.9
EROS-B	Israel	600	0.7-0.9
Ikonos-2	USA	681	1-4
OrbView-3	USA	430	1-4
Kometa	Russia	211	2-10
Spot-5	France	830	2.5-10
Resource-FIM	Russia	225	5-30
Almaz-1B	Russia	400	10-520
Sich-1M	Ukraine	650	24-25000
Ocean-O	Russia, Ukraine	668	50-1700

Space photography with high and ultra-high resolution makes it possible to identify individual trees that can effectively carry out forests monitoring, replacing aerial photography space.

IV. ENVI SOFTWARE

The growing reliance on geospatial imagery makes it increasingly important to get the critical information from imagery. Tools and processes that help easily and accurately extract information are essential, whether need information for commercial, govenment or research applications.

Today's imagery analysts, scientists, and GIS professionals in a wide variety of disciplines choose products from the ENVI line of premier software solutions for extracting information from geospatial imagery. ENVI provides advanced, user-friendly tools to read, explore, prepare, analyze and share information extracted from all types of imagery (Fig. 1) [9].

The ENVI family of products includes advanced modules to meet specialized image processing and analysis needs:

- **ENVI Atmospheric Correction Module**. Remove challenging atmospheric conditions from imagery to increase the accuracy of final results.
- **ENVI Orthorectification Module**. Accurately register imagery to ground coordinates and geometrically correct it to remove distortions.
- **ENVI NITF Module**. World-class support of the government standard NITF file format for image access, viewing processing,and analysis
- **ENVI DEM Extraction Module**. Improves image analysis workflow by creating spatially accurate, 3-D data representations.

ENVI also provides:

- **SARscape Family of Modules for ENVI**. Read, process, analyze, and output Synthetic Aperture Radar (SAR) data to integrate with other remotely sensed data and geospatial tools.
- **IDL**. One of the greatest advantages of using ENVI is ability to easily extend and customize ENVI functionality with IDL. IDL is the trusted scientific programming language used across disciplines to create meaningful visualizations out of complex numerical data.

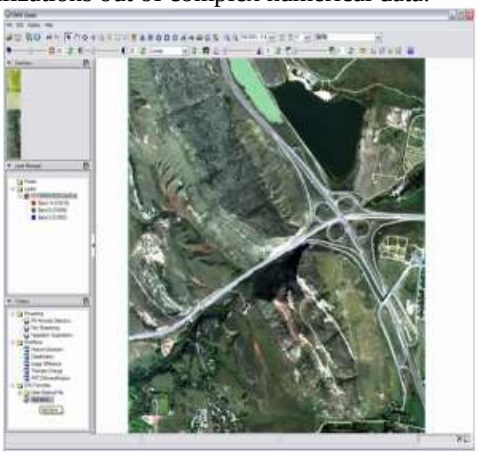

Fig.1 ENVI user-friendly tool.

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V. CONCLUSION

Topical is the formation of new forestry characteristics, building new models and algorithms to analyze and predict the state of forest development. Promising directions for implementation of forest monitoring is using the aerospace imaging systems data and specialized software.