



**Universitatea
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HABILITATION THESIS

Abstract

Long-term monitoring of human interventions to forest ecosystems using
multi-source geospatial data

Domain: Forestry

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The habilitation thesis presents a part of the results of the research carried out in the field of fundamental engineering sciences, the forestry subdomain, after public defend of the PhD thesis, in 2011, at Transilvania University in Brasov. The thesis is structured as follows: summary, professional and scientific achievements, career development plan, and bibliography.

Forest management in the past can severely affect the management and conservation of forests nowadays, and especially the watershed management. However, there are relatively few changes in forest coverage over the centuries, which limits understanding of how past management impacts current forestry practice and ecosystem conservation. From the point of view of the hydrological and soil protection function performed by forests, knowledge of disturbances of long-term forest ecosystems offers the quantification of the hysteresis phenomenon, which defines the diminishing of protective functions of forests affected in the past by disturbances. Thus, knowledge of the spatial distribution of forests affected by hysteresis would lead to a better management of the resource in the field of river basin management.

The content of the thesis is formed around the idea of long-term quantification of anthropogenic influence on forest ecosystems and on the dynamics of mountain torrential valleys. There are 4 research directions based on articles published as the main author (first author or correspondent author) in prestigious international journals indexed by ISI WOS. These four research directions are developed vertically, starting from a macro level - quantifying the anthropogenic influence at national level, and reaching a micro level - quantification of the anthropic influence at the level of a torrential valley as follows:

- Monitoring the long-term anthropogenic influence on forest ecosystems
- Dynamics of forests in mountain basins using satellite imagery and climatic data
- Forest management and impacts on water resources using geospatial analysis
- The long-term dynamics of the riverbed in a torrential valley

The results of the six years of research highlight the use of geospatial multi-source data described in 4 chapters.

Chapter 2 presents a study covering a period of 100 years and is based on two papers published in international prestigious journals in Forestry and Remote Sensing, Forest Ecology and Management respectively Remote Sensing of Environment. The study in Chapter 2 shows how forest disturbances have evolved at 4 important points in the history of Romania: 1920 the beginning of Great Romania, 1955-1965 the period of compensation for war damage to the Soviet Union, 1965-1990 the socialist period and 1990 - 2016 postdecembrist period. We have found that the forest area has grown in Romania since 1924 by 5% and that the annual harvesting rate between 2000 and 2013 was half the annual rate between 1912 and 1922. For the post-war period, namely from 1955 to 1965, the forests affected by cutting and definitive cutting were quantified. This period is known as a stage in which Romania's economy has returned from war, has established close economic

ties with the Soviet Union, and paid by exporting timber to the Soviet Union. To achieve this, we have developed a precise and rapid method of orthorectification of US high-resolution Corona spy satellites that swept across the planet between 1962-1972. We have identified 530,000 ha of clear-cuts and definitive cuts that are three times larger than the cuts that are nowadays cut. Research provides quantitative evidence that wars can cause long-term effects on the environment. The approach presented in the study facilitates the expansion of data recording for space observation one to two decades earlier than is possible with satellite data sets and Corona data is available globally.

Chapter 3 presents the altitude and latitude development of the forest boundary in mountain hydrographic basins, this aspect being directly related to the activity of small river basin management, predominantly forestry, a study published in the international journal *Climate Research*. The intensity and speed of the advancement of the forest boundary also depend on numerous physical, biological and human factors that are specific to the region. We selected four study areas to analyze the temporal and spatial behavior of the forest and forest line on the basis of selection criteria such as minimal human interference and maximum European representativeness. Four time intervals were used to assess forest cover behavior against non-wooded areas: 1971-1980, 1981-1990, 1991-2000 and 2001-2014. Also, climate and topography data, such as temperature trends and local topographic features, have been included in this study, factors that have made it possible to compare and calculate dependency relationships. Our results indicate significant differences between the analyzed areas. For example, for the same reference period (1981-1990), the greatest differences in the change in forest cover were + 28%. As a result of the climate data analysis, the temperature trend significantly influenced forest evolution in the mountain area, which has direct implications for the management of predominantly mountainous, mountainous hydrographic basins.

In Chapter 4 there are presented aspects regarding the influence of disturbances occurring in the last 10 years in the Romanian forests on the fulfillment of the hydrological and anti-erosion function. A geomatic method of quantification of disturbances is presented and a national survey on spatial distribution and patterns of these disturbances at the level of the forest fund is carried out.

Chapter 5 presents an in-depth study of the anthropogenic effects on a torrential valley, more precisely on the dynamics of minor bed morphometry. The study was published in the *ISI - Environmental Engineering and Management Journal* indexed journal. Using complex geomatic techniques and data from different sources and formats, it was possible to reconsider the evolution of the minor bed of a torrential valley after the installation of transverse hydrotechnical constructions.

The final part of the paper presents the development plan of the university career (in research, didactic activity and relation with the economic environment). The empowerment thesis ends with the list of bibliographic references mentioned in its contents.