ANNUALLY SPATIAL PATTERN DYNAMICS OF FOREST TYPES UNDER A RAPID EXPANSION OF IMPERVIOUS SURFACES: A CASE STUDY OF HANGZHOU CITY

Bachelor's thesis

Performed by: Yuxin ZHU, student of the 4th year, group GK-42
Scientific supervisor: PhD, assoc. prof. Olena AHAPOVA
V.N. Karazin Kharkiv National University, 2024
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ABSTRACT

The relevance of the research lies in dramatic forest dynamics strongly influence pressure mitigation from the increasing population and climate changes of an urban landscape. Effectively monitoring landscapes in a spatiotemporally consistent manner, satellite remote sensing has emerged as the first analytical tool to help us understand the changes in urban forests. At present, most studies focus on classification algorithms, spatial analysis methods, and ecosystem models, and the literature lacks spatiotemporally explicit research on the responses of different types of forests to urbanization. Thus, in this study, Hangzhou was selected as a typical metropolitan area to determine the annual spatial patterns of urban forests at a forest-type level. To illustrate the spatial pattern dynamics of different forest types resulting from rapid urbanization, this study characterized the Landsat-based spatial patterns of different forest types, as well as their annual changes from 2000 to 2022 using object-based backdating classification, land-use transfer matrix, area-weighted centroids, and landscape pattern indexes. The spatiotemporal effects of impervious surface expansion on forest pattern changes at a type scale were discussed. The results demonstrated that forests, mainly located in the southwest, decreased from 11,660.69 to 11,516.15 km^2. Moreover, evergreen broadleaved forests occupied the largest area and had the most decreased ratio among the three forest types over 23 years, followed by evergreen needle-leaved and deciduous broadleaved forests. In

total, 103.37 km^2 of forest areas transformed to impervious surfaces, with the highest annual transformation of area occurring among evergreen broadleaved forests widely across Hangzhou City and the lowest occurring among deciduous broadleaved forests. Forests lost adjacency due to the development of Hangzhou City, while this south-westward shrinkage slowed down over 23 years, resulting in the highest increase in the degree of evergreen broadleaved forest fragmentation. Therefore, measures of city planning according to the deep effects of adjustments of administrative divisions to forest suitability should be implemented, such as green ecological corridor construction. This research provides a Landsat-based methodology at a spatiotemporally explicit-scale perspective for better understanding forest changes under high-speed urbanization.

The object of the research is the forest resources, and **the subject** is the change of various forest types under the rapid urbanization of Hangzhou.

The purpose of the research is to assess the dynamics of annual spatial pattern of forest types under rapid expansion of impervious water surface. As such, the **tasks** of this study were to:

1) Map the annual spatial distributions of various forest types.
2) Quantify the spatiotemporal transformation of different forest types to impervious surfaces.
3) Analyze the relationship of spatiotemporal patterns between the forest type and impervious surface.

Research methods. In the research process, a number of summer and winter satellite images were selected to analyze the land use transfer matrix, spatial centroid and landscape pattern index. To visualize the results, we created 23 maps of age forest types in these areas.

Structure of the work. The study consists of three chapters, introduction, and conclusions, arranged in 44 pages. The reference list includes 54 positions. Contains 9 figures and 1 table. The findings are published in Forests 2024, 15(1), 44.