1. PHD PROJECT DESCRIPTION

Project title: ***Impact the size and shape of the reference field on landscape heterogeneity modeling results***

1.1. Project goals

The contemporary image of the spatial landscape pattern is the result of activities and processes taking place in the analyzed area in the past periods. Landscape mosaic is analyzed using the various spatial data available, both vector and raster, as well as indicators and indices. The selected size and shape of the base field have a significant impact on the results of spatial analyzes used to model landscape heterogeneity.

The aim of the project is to determine the influence of the size and shape adopted for the analysis of the basic field used to model landscape heterogeneity. The land cover / use and its variability over time will be the main modeling element.

1.2. Outline

Heterogeneity means diversity, variety or non-uniformity. In landscape ecology, heterogeneity (mosaicism) means its diversity resulting from taking into account the following criteria: biological, geographical or ecological. The state of the landscape, the direction of its changes, as well as the proportions between the categories of land use can be described by means of indices and indicators of the spatial pattern. They are used to determine the durability of the landscape, order and naturalness, as well as sensitivity to external factors, mainly in the form of human activity. Various indices and indicators are used to assess the heterogeneity of a landscape, including indices of greatness and size of patches, indices of edges, indices of shape (including fractal dimensions), indices of diversity and fragmentation.

A significant problem in the study of landscape heterogeneity is the size and shape of the primary field selected for detailed analyzes. These input parameters influence the quality and outcome of the landscape change modeling process as well as the uncertainty of the analyzes. The search for optimal variables is therefore a necessary and expected activity.

As part of the project, analyzes and simulations will be performed using both vector and raster data (satellite imagery) and various input parameters. The result of the work is to be recommendations for the modeling process of land cover changes, which will allow for the elimination of the negative impact of the size and shape of the base field selected for analysis.

1.3. Work plan

The project will be realize within four years. The following main stages can be distinguished:

- selection of research areas for research on landscape heterogeneity,
- collections of contemporary and historical cartographic, topographic and thematic materials,
- selection and acquisition of remote sensing data,
- building a dedicated GIS system,
- selection of landscape indices and indicators used in the analysis of landscape heterogeneity,
- simulations and modeling using different sizes and shapes of primary fields.
- determination of the sensitivity of the model of changes in landscape heterogeneity due to the adopted basic field,
- creating recommendations for determining landscape heterogeneity.

1.4. Literature

- Cambui E.C.B., de Vasconcelos R.N., Boscolo D., da Rocha P.L.B., Miranda J.G., 2015, Gradient-Land Software: A landscape change gradient generator, *Ecological Informatics* 25: 57–62.
- Kunz M., Nienartowicz A., 2007, The influence of past human activity gradient on present variation of NDVI and texture indices in Zabory Landscape Park, [In:] Z. Bochenek (ed.), *New Developments and Challenges in Remote Sensing*, Millpress Science Publishers, Rotterdam, Netherlands: 171–184.
- Kunz M., Nienartowicz A., Filbrandt-Czaja A., 2003, Spatial pattern changes in Bory Tucholskie forest landscape, [In:]: T. Benes (ed.) *Geoinformation for European-wide Integratio*n, Millpress Science Publishers, Rotterdam, Netherlands: 447–453.
- Lausch A., Herzog F., 2002, Applicability of landscape metrics for the monitoring of landscape change: issues of scale, resolution and interpretability. *Ecological indicators* 2(1–2): 3–15.
- Li H, Wu J., 2004, Use and misuse of landscape indices, *Landscape Ecology* 19: 389–399.
- McGarigal K.U., Cushman S., 2005, *The Gradient Concept of Landscape Structure.* 10.1017/CBO9780511614415.013.
- McGarigal K., Marks B.J., 1995, Spatial pattern analysis program for quantifying landscape structure. Gen. Tech. Rep. PNW-GTR-351. US Department of Agriculture, Forest Service, Pacific Northwest Research Station, 1–122.
- Sklenička P., Lhota T., 2002, Landscape heterogeneity—a quantitative criterion for landscape reconstruction. *Landscape and urban planning* 58(2–4): 147–156.
- Uuemaa E., Antrop M., Roosaare J., Marja R., Mander Ü., 2009, Landscape metrics and indices: an overview of their use in landscape research. *Living reviews in landscape research* 3(1): 1–28.

1.5. Required initial knowledge and skills of the PhD candidate

- practical knowledge of using GIS software (ArcView, QGIS and others),
- programming skills,
- practical knowledge of remote sensing data processing software,
- practical knowledge about topographic maps and cartographic historical data,
- interests related to the subject of the project,
- analytical thinking ability,
- independence and creativity in solving scientific problems,
- research passion and enthusiasm,
- distance to reality,
- teamwork skills are not required.

1.6. Expected development of the PhD candidate's knowledge and skills

The candidate for doctoral studies should develop in the field of effective use of geoinformatic tools for analyzing the condition and functioning of the natural environment as well as methods of integration of different thematic and time-series data sources. It is assumed that the PhD will develop knowledge in the field of assessing the diversity of landscape over time, and also determine the causes and their strength affecting the observed image of the landscape mosaic in the short and long term. Students should also develop their skills in the practical field of using GIS in nature research. The envisaged development should prepare for conducting independent scientific research at the interface of geography and landscape ecology.