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Application of Artificial Neuron Networks for Purposes of Urban Planning (the Example of the City of Kazan)

The landscape structure of a territory imposes serious limitations on the adoption of certain decisions. Differentiation of the relief into separate elementary geomorphological sections yields the basis for most adequate determination of the boundaries of urban geosystems. In this paper the results of approbation of relief classification methods based on Artificial Neuron Networks are presented. The developed model of the restored landscapes represents the city territory as a system of geomorphologically homogenous terrains. The results can be used in the analyzing of informal arrangement of a territory, which is necessary for the adjustment of visual properties of a landscape by planning methods.

Key words: Artificial Neuron Networks, urban geosystems.

Introduction

City is a very complex system characterized by the concentration of a dense population within a compact settlement area. Such clustering of people predetermines high concentration of the entirety of economic and social relations, which inevitably leads to the creation of a complex, and sometimes self-contradictory, system. The conflict of interests in the given system generates a considerable and diverse set of problems to do with most different aspects. One of such aspects is a sphere of effective planning and protection of the environment.. Intensive growth and development of urban agglomerations urge for the effective use of the limited resources of the urban territory (Makarov, 2002).

Land-use planning and adoption of managerial decisions in conditions of urban territories, from the viewpoint of inventory and proper organization of a geographical space, would be facilitated if a city was built on a plain site of homogeneous genesis. The entirety of conditions for decision-making would be determined by the peculiarity of a relative position of certain objects within the urban system: residential and industrial areas, objects of infrastructure, planted land, etc. In other words, only specific zoning of a city would be necessary. Should it be the case, the exact location of a certain object of the urban system would not be so important; whereas its position in relation to other objects would be of greater significance. Certainly, such an 'ideal urban geospace' does not exist in reality, not even in small towns. Unfortunately, managerial decisions in cities are often made either without regard to any natural characteristics of a specific territory, or with regard to just a few factors. Many types of activity are not possible on certain sites, or, although possible on the other sites, are rather ineffective. This is true not only about nature preservation and rational use of natural resources, but also the entirety of human activity in the cities. Most often, neglect of system properties of urban agglomerations reduces the efficiency of the activity to zero. Consequences of such 'inefficiency' are extremely obvious in the case of large-scale transformations of a landscape structure of urban systems. As a case in point one can take the development of the infrastructure for the World University Games to take place in 2013 in the city of Kazan. Planned comprehensive transformation of a number of natural ecological systems (river Kazanka, Lake Kaban, coastal territory, etc), neglect of a scientifically grounded impact of such transformations on the environment and of public opinion led to the escalation of the social unease in the city.

Qualified managerial decisions in a big modern city should be based, first of all, on full and reliable information on key subsystems; in particular, on the environmental situation in the city. Attempts at distinguishing in a city of landscape elements of different taxonomy by traditional approaches are oftentimes doomed to failure by virtue of either full or partial transformation of soil covering, biogeocenoses, underground waters and even composition of underlying rock. In conditions of the transformed in the result of human activity natural territorial complexes of modern cities one can hardly mark out even large enough landscape formations (district, subdistrict). The question arises; can certain territorial units within the urbanized territories (construction zones) be called landscapes in the usual sense of the word? In this sense 'landscape' mapping of urban territories should be based on the most reliable diagnostic property allowing for regional differentiation of geosystems, the source of a true information about the landscape structure of a city - the relief. Differentiation of the relief into separate elementary geomorphological sections yields the basis for most adequate determination of the boundaries of urban geosystems.

Development of computer engineering and advanced information technologies allow for the use of modern geoinformation systems for effective modeling of the environment. The volume of information used in the analysis of landscape systems is so big, that it can only be processed and analyzed with the help of GIS technologies.

Application of GIS technologies in the landscape mapping proved to be very successful, in particular, in classification of landscape units. Artificial Neuron Networks (ANN) are among the newest signal-processing technologies in the engineer's toolbox, allowing for the objective zoning even without regard to the detailed information about the processes in a given system. Kohonen self-organizing maps (SOM) are one of the types of ANN. They are often used for resolution of most diverse problems, ranging from refilling data gaps to the analysis of data and search of consistent patterns. SOM method also proved to be efficient in biochemical research, management, and especially in solving a wide spectrum of