



## **Application of neural networks and geomorphometry method for purposes of urban planning (Kazan, Russia)**

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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 paper the results of approbation of relief classification methods based on Artificial Neuron Networks are presented. Approbation of Artificial Neuron Networks (ANN) method (Kohonen's Self-Organizing Maps - SOM) for purposes of automated zoning of a modern city's territory on the example of the city of Kazan. The developed model of the restored landscapes represents the city territory as a system of geomorphologically homogenous terrains.

Main research objectives: development of a digital model of relief of the city of Kazan; approbation of relief classification methods based on ANN and expert estimations; creation of a SOM-based map of urban geosystems; verification of the received results of classification, clarification and enlargement of landscape units; determination of the applicability of the method in question for purposes of zoning of big cities' territory, identification of strengths and weaknesses.

First stage: analysis and digitalization of the detailed large-scale topographic map of Kazan. Digital model of the relief with a grid size of 10m has been produced. We have used this data for building various analytical maps of certain morphometric characteristics of the relief: height, slope, exposition, profile and plan curvature. Calculated morphometric values were transformed into a data matrix. Software packages use training algorithms without the use of a tutor, whereas weight coefficients are redistributed for each specific operational-territorial unit. After several iterations of the "education" process, neural network leads to gradual clumping of groups of operational-territorial unit with similar sets of morphometric parameters. 81 classes have been distinguished. Such atomism was eliminated by way of consolidation and interpretation of the obtained results on the basis of classes' affinity.

The final product, geomorphologic zoning map, includes good representations of bench complexes, although the flood-plain bench and first terrace above flood-plain turned out to be united. Most likely, first terrace above flood-plain has been distinguished on the basis of other parameters, such as lithogenic structure. Identification of territories with different slopes yielded good representation of terrace cusps and ravine-gulch network. Accumulation and denudation slope sections are clearly visible, too. Poor representation of classes determined by the leading role of plan curvature and a questionable weighty part of exposition probably resulted from insufficient calibration of initial parameters of the program

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The obtained in the result of the analysis SOM-based landscape classification map allows for the preliminary zoning of territory for certain forms of economic activity. 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.