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PECULIARITIES OF INFORMATION TECHNOLOGIES FOR PROCESSING OF DATA ARRAYS OF ENVIRONMENTAL MONITORING OF NATURAL AND TECHNOGENIC OBJECTS OF DIFFERENT SCALE IN GEOINFORMATION SYSTEMS

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Introduction.

The development of computerized systems for environmental monitoring of objects of various sizes is an important direction in modern environmental research and in practical activities for the protection of the environment and public health. This task is very relevant for spatially dispersed objects that differ in a number of features, such as: distribution over a large area; the complexity of organizing regular monitoring and maintenance; continuous operation in an aggressive environment; large capital and operating costs for the creation and use.

The paper presents an analysis of information technologies for processing data arrays of environmental monitoring of natural and man-made objects of various scales in geographic information systems (GIS).

Main part.

It is known that traditional methods of collecting and processing a data array during the operation of environmental monitoring systems do not allow, without the use of modern computer information technologies, to obtain reliable operational information, to model the level of technogenic loads on the components of the natural environment, to make expert and predictive assessments for making optimal management decisions. In recent years, one of

the main directions in the development of environmental monitoring systems has been the use of promising information technologies, the latest software developments and multifunctional analysis tools called GIS. A modern geographic information system can be defined as a set of hardware and software tools, geographic and semantic data, designed to receive, store, process, analyze and visualize spatially distributed information.

The main advantage of GIS lies in the set of tools for creating and combining databases with the possibility of their geographic analysis and visualization in the form of different maps, graphs, diagrams, direct linking to each other of all attributive and graphic data. GIS uses various methods of information transformation: into a given coordinate system, classification of monitoring objects by their attributes, generalization, spatial modeling and interpolation. Classification and clustering methods are widely used to classify spatial data according to the indicators used. Automated image analysis, in particular multispectral data, uses supervised and unsupervised classification algorithms. Monitoring of changes in ecological systems requires the use of algorithmic procedures for detecting dynamic changes (dynamic maps). Such procedures are based on classification methods and overlay GIS technologies. For these purposes, compositions of multi-temporal images, image algebra, comparison of the results of classifications of equally temporal images, etc. are used. To implement a decision-making system for monitoring natural and man-made objects of various scales, the apparatus of fuzzy set theory is used.

In computerized environmental monitoring systems, it becomes possible to carry out remote generalization - geometric and spectral generalization of images in images, determined by a complex of technical factors and natural features of the environment. In this case, the spectral and geometric characteristics of objects are integrated (synthesized), and a change in the image detail leads to a restructuring of its structure. In particular, automatic (logic-

machine) generalization manifests itself in a formalized selection, smoothing and filtering of an image in accordance with specified formal criteria.

An important component of modern information technologies for processing arrays of environmental monitoring data has become the use of intelligent systems based on fuzzy logic in the analysis of environmental situations in geographic information systems. It is known that the tasks of improving the environment include solving many complex, non-linear tasks that are difficult to formalize and require knowledge in many aspects of the environment, including environmental monitoring. Modern environmental monitoring tools and the information and control systems that support them are complex multifunctional multi-mode distributed systems in which complex data and knowledge are processed jointly. The most striking feature of human intelligence is its ability to make correct decisions in an environment of incomplete and fuzzy information. Therefore, modern automated monitoring systems should be considered as systems that, in terms of these properties, approach a person, and which help him influence the state of the environment. They should be developed on the basis of modern information technologies that would provide them with a significant increase in the level of information and intellectual support.

The main advantage of GIS lies in the set of tools for creating and combining databases with the possibility of their geographic analysis and visualization in the form of maps, graphs, diagrams, direct linking to each other of all attributive and graphic data. Modern environmental GIS allows you to work with maps of various ecological layers and automatically build a map of a qualitative assessment of environmental hazards. This process requires a highly skilled expert. Therefore, there is a need to automate the decision-making process and modeling the processes of approximate reasoning of a person becomes the central direction of automating the activities of a decision-maker based on an analysis of the environmental situation. Environmental monitoring

systems based on GIS can be considered as intelligent systems based on human knowledge. For this, the existing GIS was supplemented with a decision-making subsystem. The relevance of considering this class of systems is due to their ability to accumulate and generalize knowledge, to develop hypotheses, forecast and make decisions.

When solving environmental problems, situations arise when either the necessary sensors of primary information are not available, or existing measuring instruments do not provide the required information at the pace of the process, or only qualitative information about the control object is available. In such situations, it is necessary to have information technologies that provide decision-making that would allow obtaining the required information based on computer processing of high-quality or fuzzy information about the object. The methodology and software for creating the required model of an environmental monitoring system are based on fuzzy mathematics and are based on the hierarchy analysis method and fuzzy set theory, in which the main part of the information necessary to build a model is qualitative or fuzzy. To select a clear value of the control function, the method of weights is used. To implement a decision-making system, the apparatus of the theory of fuzzy sets can be used. As a mathematical model of weakly formalized problems, fuzzy control algorithms are used, which make it possible to obtain approximate solutions that are no worse than when using exact methods. With the help of fuzzy sets, it is possible to create methods and algorithms capable of modeling human decision-making techniques in the course of solving various problems. In particular, it is possible to carry out a classification, on the basis of which a decision-making system is built. Methods of the theory of fuzzy sets allow: a) to take into account various kinds of uncertainties and inaccuracies introduced by the subject and control processes, and to formalize the verbal information of a person about the task; b) significantly reduce the number of initial elements of the control process model and extract useful information for constructing a control algorithm.