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ANALYZING THE DISTRIBUTION OF POLLUTANTS IN URBAN LANDSCAPES

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A B S T R A C T	***K E Y W O R D S***
Environmental quality control is one of the most important functions of environmental protection, as it is aimed at creating reliable information for planning and implementing effective environmental protection measures. Researching environmental monitoring is associated with problems such as large-scale analytical work, large financial costs, imperfect methodological support for environmental situation assessment, multidimensional data bank processing, and others.	Environmental situation, effective environmental protection, urban landscapes, environmental control.

Introduction

The need to develop new measures for environmental protection and improve the quality of the environment is particularly relevant for cities that are, as a rule, developed industrial centres and, therefore, areas of increased environmental risk [1,2,3]. The city is an industrial and communal structure that creates wide anomalies of pollutants in the composition of natural compounds and compounds of man-made origin. Mapping of areas of increased or decreased concentrations of controlled compounds compared to background or standard concentrations is based primarily on the results of depositional (accumulating) environment testing [4,5,6]. For an objective assessment of the ecological situation, among other information, information on spatial and temporal changes in the concentration of toxic compounds in the environment is required. Determining the most informative parameters of environmental monitoring plays an important role in describing the trends in the formation of polluting anomalies, as well as in determining the necessary and sufficient list of indicators that require systematic monitoring [7,8]. In this regard, multivariate data analysis, which uses a probabilistic approach to study the interaction of initial values, plays an increasingly important role in environmental studies. as well as determining the necessary and sufficient list of indicators that require systematic monitoring. In this regard, multivariate data analysis, which uses a probabilistic approach to study the interaction of initial values, plays an increasingly important role in environmental studies. as well as determining the necessary and sufficient list of indicators that require systematic monitoring. In this regard, multivariate data analysis, which uses a probabilistic approach

to study the interaction of initial values, plays an increasingly important role in environmental studies [9,10,11].

The Main Part

The work aims to optimize the environmental monitoring system based on multidimensional modelling of the distribution of pollutants in urban landscapes [13,14,15].

To achieve this goal, the following research tasks were defined:

1. To study the problems of environmental information collection and processing in lower cities. Analysis of existing methods of evaluation of urban landscapes from the point of view of probabilistic-statistical research. Development of an optimal analysis method for the assessment and classification of the distribution of pollutants in cities.
2. Development of a mathematical model to describe the distribution of multidimensional pollution fields in urban landscapes. Development of spatial and temporal patterns of pollutant distribution in different environments.
3. Development of a method of classification and reduction of the size of the field of environmental control parameters (pollutants and sampling points).
4. Development of methodological recommendations for the analysis, classification and reduction of the dimensions of the multidimensional space of the results of urban landscape monitoring, which allows for the optimization of the system of environmental protection measures [16,17,18,19].

To date, the geochemical method of assessing the state of the environment is the leader due to the possibility of studying the complex structure of urbanized zones by detailed mapping of pollution anomalies. Elementary statistics, correlation analysis, and comparison of actual pollutant concentrations with permissible maximum or background values are used as mathematical processing of geo-ecological data, and the following are suggested.

1. It is proposed to use the multifactorial method of main components in environmental monitoring of urban landscapes.
2. A mathematical model is proposed for the classification of controlled toxic metals and sampling points in the environment, including their neighbours, based on the principal component method.
3. During 10 years of geochemical monitoring, the dynamic properties of the distribution factors of the concentration of toxic metals were studied.
4. Guidelines for optimization of environmental monitoring of urban landscapes were developed based on the method of multivariable principal components.

The reliability of scientific rules, conclusions and recommendations is related to the correct application of mathematical methods of research, experimental verification of theoretical rules, and the use of standard methods and standards of environmental quality control at all stages of work [20,21,22].

The proposed algorithm for classification and analysis of the factors of the formation of controlled pollution processes allows for a more accurate assessment and prediction of the ecological situation in urban landscapes, as well as reduces the number of sampling points required for assessment [23,24,25].

The conclusions drawn from the results of the research became the basis for the development of an action plan for the optimization of environmental monitoring in cities.

This article provides the following rules:

1. Mathematical modelling of the distribution of pollution intensity of urban landscapes and justification of the use of the multifactorial method of principal components to reduce the area size of controlled parameters of environmental monitoring.
2. Method of multifactorial classification of heavy metals and control points of sampling of different environmental environments in the space of major components.
3. Component model of the dynamics of the distribution of pollutants in the conditions of periodic ecological control of the environment.
4. Guidelines for the evaluation and optimization of measures for monitoring the means of deposition using orthogonalization methods for the correlation parameters of environmental pollution.

Biochemical studies are carried out with the help of such parameters as ecological status, water-physical and chemical-physical properties of soils as the concentration of heavy metals (Pb, Cu, Ni, Co, Zn, Mn, Cr, V). Soil field testing is carried out in 22 control studies, for which annual vegetation samples are taken simultaneously with soil samples [26,27,28].

The geochemical method of studying the migration of chemical substances, used in environmental monitoring of other cities of the region, is based on the principles of express landscape-geological mapping of toxic substances without long-term stationary observations.

The functional scheme of geochemical research objects and methods within the framework of environmental monitoring of the city of Rostov-on-Don includes the following objects. Monitoring of the environmental condition of the atmosphere is carried out in 3 directions: determining the concentration of toxic substances in cells;

in dust and the air of the direct observation zone. The number of selected lithochemical samples of one geochemical study is about 2000. It was conducted in 1989, 1992, 1995 and 1998 with 3-year intervals. The composition of mobile forms and the total amount of toxic metals in soil samples are analyzed: Cr, Pb, Cu, Ni, Co, V, Zn, Ml, Sr and other factors. Physico-chemical properties of soils are determined by standard methods of analysis of water extract of the sample.

Results

During the orthogonal decomposition of the standardized vectors of the initial matrix of variables, three main components f1, £2, and £3 were obtained, which determine the general trends of distribution of all considered metals in the soil cover (Fig. 1).

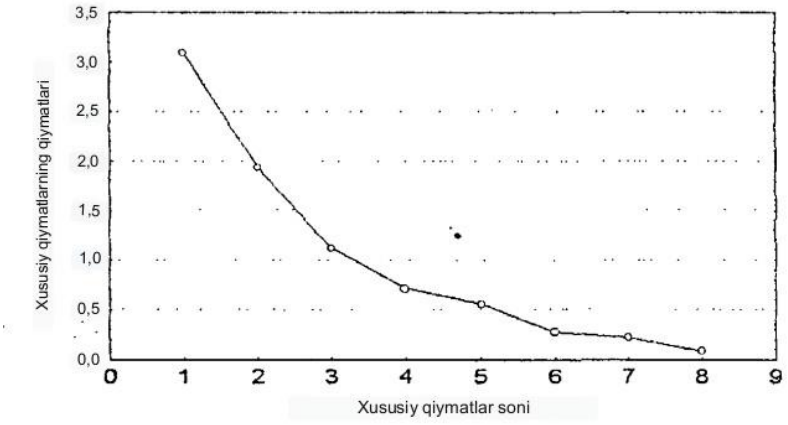

Figure 1. General trends in the distribution of metals

A similar study was conducted with data on the composition of the same metals in samples of X2(8x22) annual plants.

The range of factor loading coefficients of these metals is 0.67-0.95. The obtained components made it possible to rearrange the S-dimensional space of the original variables into the 3-dimensional space, preserving 77% of the total variability, which is characterized by the distribution of the metal concentration distribution at the control points (Table 1).

Table 1. The results of calculating the eigenvalues of the matrix R1

Qism raqami	Xususiy qiymatlar	Dispersiya ulushi,%	Yig'ilgan xos qiymatlar	Yig'ilgan dispersiya,%
1	3,09	38,65	3,09	38,65
2	1,94	24,21	5,03	62,86
3	1,12	14,05	6,15	76,91
4	0,71	8,91	6,87	85,82
5	0,56	6,98	7,42	92,80
6	0,27	3,42	7,70	96,22
7	0,22	2,77	7,92	98,98
8	0,08	1,02	8,00	100,00

The graphic representation of metals in the first two columns f1-f2 coordinates shows that two clusters A and B can be distinguished (Fig. 2). Changes included in cluster A are characterized by high values of the f1 component and reflect the distribution patterns of zinc, copper and cobalt compounds in the adjacent environment. The distribution of metals in cluster B is determined by the f2 or - f3 component. The relationship between the distributions of metals in the surrounding environment was determined for chromium compounds (characterized by the f2 component) and lead (f1 component).

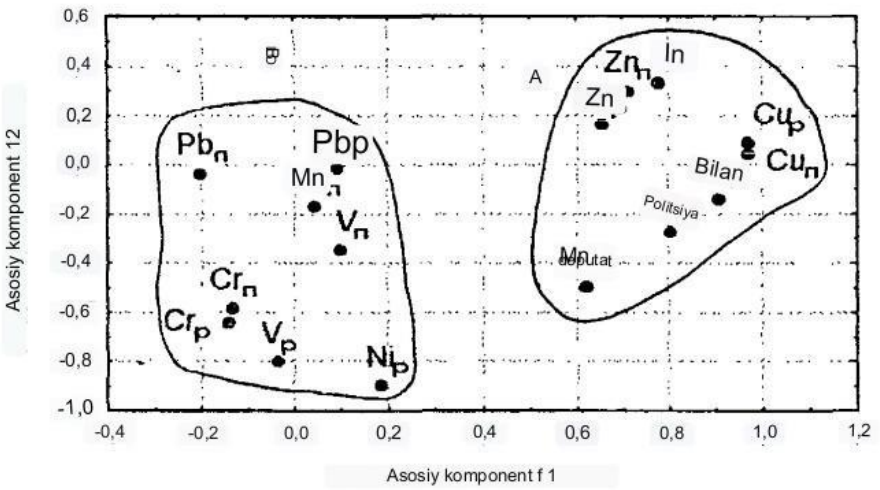

Figure 2. The relationship between the distribution of metals in the surrounding environment

Thus, the factors of pollutant variability were tested separately in both depositional environments and adjacent regions by the principal components method. An additional advantage of the classification of pollutant distribution is the use of relative rather than absolute indicators of control, which makes it possible to take into account the systematic error of research methods and increase the accuracy of the assessment of observations.

Conclusion

1. An analysis of environmental pollution monitoring and forecasting methods was conducted, based on which general approaches to creating a more effective model for describing environmental monitoring parameters were determined.
2. A mathematical model is proposed, in which the multifactor component method is used to describe the distribution of pollutants in terms of their concentration at control sampling points (direct problem) and the pollutants of sampling points concentration distribution model (inverse problem).
3. Based on the principal component method model, an algorithm for reducing the dimensions of the multidimensional space of environmental control parameters is proposed, which has practical application for reducing sampling points or the number of analyzed pollutants.
4. A multi-factor classification method of pollutants was developed!! or observation points in the space of the main components that allow to increase the accuracy of taking into account the impact of external factors on the environmental situation and optimize the system of environmental protection measures.

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