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Analysis of Existing Approaches to Mapping Environmental Pollution

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Abstract: According to N.F. Reimers (1990), pollution is understood as the introduction into the environment or the emergence in it of new, usually uncharacteristic for it, physical, chemical, biological, informational agents or the excess of the natural long-term average concentration level at the considered time, leading to negative consequences. With such a broad interpretation of the concept of pollution, its traditional division into chemical, physical and biological becomes insufficient and is supplemented by geological and geomorphological.

Keywords: maps, thematic maps, pollution, pollution sources, remote sensing, bio-indicator, biosphere, toxic substances, enterprise discharges, environmental protection.

Introduction. The degree of anthropogenic transformation of natural complexes and their components, being a general concept, cannot be directly measured. Any information used to quantify the magnitude of the anthropogenic load (data on the chemical composition of natural objects, the intensity of physical fields, pollutant emissions, etc.) is more or less indirect and, due to complex relationships in the geo-system, is incomplete[1]. Each of the geo-components is the subject of study of the relevant science (meteorology, hydrology, soil science, etc.), while the methods of their study (physical, chemical, economics-statistical, etc.) are largely borrowed from other areas of knowledge. In all specific sciences, concerning both the components of the environment and the ways of studying them, along with general scientific ones, there are also specific laws, methods and related restrictions related to the possibilities of obtaining and interpreting results[2], [3].

Formulation. Therefore, the synthesis of information about the environmental situation from different sources must be preceded by an analysis of the sources of information themselves. Such an analysis includes: identification of the natural-science and social-humanitarian essence of indicators and characteristics; consideration of the factors determining these indicators and characteristics, including natural, anthropogenically transformed, anthropogenic; search for opportunities to identify those components of indicators and characteristics that would reflect the magnitude of the anthropogenic transformation of geo-systems; assessment of reliability, objectivity, spatial and temporal variability of indicators [4], [5].

Since information about the environmental situation obtained from different sources is often contradictory, and the degree of its reliability and objectivity is not the same, it is necessary to develop some rules for its verification and comparison, based on the delimitation of the functions of information sources. The use of previously created thematic maps as a source of pollutometric information is justified only in terms of the most stable characteristics over time. n all other respects, it is more expedient to refer directly to cartographic sources[6]. The division of cartographic sources, according to K.A. Salishchev (1982), into astronomical-geodesic, survey-cartographic and thematic (graphic, text and digital) or, according to S.E. Salnikov et al. (1990), into survey-cartographic , documentary and reference literature needs to be detailed. It is expedient to carry out this detailing according to the methods of studying the ecological situation, since any cartographic source is primary or secondary in relation to the results of the study. In total, 4 sources of information about the environmental situation can be distinguished:

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remote sensing; characteristics of pollution sources; determination of pollution indicators; bio-indicators. The greatest effect is the complex use of information from all these sources. Complexity is not equivalent to the sum and should be ensured by: delimitation of the functions of information from different sources, based on their capabilities and features; mutual verification and comparison of data; integration of materials into generalizing characteristics[7].

Remote sensing is most effective in the work related to the problems of protection of land, water and plant resources. The possibilities of studying pollution with the help of space-aero-photographic methods are much more modest and relate more to the territorial than to the quantitative characteristics. The high efficiency of remote methods, being an advantage in solving monitoring problems, turns into a disadvantage when it comes to mapping indicators averaged over a long period. I.M. Nazarov, A.N. Nikolaev et al. (1983) subdivide remote sensing methods into passive ones, i.e. based on capturing radiation from natural sources, and active, i.e. involving the use of artificial radiation sources[11], [10]. The possibilities of obtaining quantitative characteristics of the pollution of natural environments appeared in connection with the development of the latter. The use of the characteristics of pollution sources as initial data for ecological mapping is determined by the mass nature and availability of this information, on the one hand, and the relatively low reliability and objectivity, on the other.

Data on pollution volumes are presented by organizations that are not objectively interested in their completeness, based on calculation methods that are far from perfect. For some classes of pollution sources (dusty surfaces, mobile sources, diffuse pollution from agricultural enterprises and rural settlements) there are only very approximate methodologies based on normative estimates that involve assumptions and simplifications. Mapping based on the characteristics of pollution sources is not so much a scientific as an applied task, including the reduction of statistical reporting to a cartographic form convenient for verification by mathematical modeling of scattering processes. The convergence of the calculated and actual concentrations of pollutants should serve as an indicator of the reliability of the characteristics. However, none of the existing calculation methods in the world has passed a full-scale test due to technical complexity and high cost (Gavrilov, 1992) [13], [14].

Results and discussion. Components of the natural environment can be divided into dynamic (transporting pollution) and depositing (accumulating pollution). The difference between them is not so much quantitative as qualitative. It is due to different ratios of the rates of input and DE concentration of pollutants. The consequences of this are: the complex variability of concentrations in the dynamic components of the environment and the relative accumulation in depositing ones; different role in the biosphere, because the dynamic components of the environment are directly life-supporting, while the depositing components affect human health and the state of the biota as a whole more or less indirectly. Physics-chemical methods of analysis used to determine the concentrations of pollutants, in terms of accuracy, the development of implementation methods, are obviously incomparable with other methods of monitoring the natural environment. The problems associated with the use of analytical data on the environmental situation are, first of all, problems of ensuring representativeness. Compared to other methods of obtaining environmental information, sampling is most discrete: in space, in time, and in terms of the composition of ingredients[15]..

Status of bio-indicators, i.e. organisms that are sensitive to changes in the external environment is a kind of resulting indicator of the ecological situation. Among their obvious advantages are the constant nature of the perception of external influences and the objectivity of reactions to these influences. In principle, any reaction of the organism to the state of the environment is bio-indicative; however, information about the content of such an impact can only be obtained by studying a specific reaction, i.e. one in which the changes occurring can be associated with a certain factor. The nature of the organism's reactions, as well as the content of its connections with the environment in general, is the more complex and ambiguous, the more complex the organism itself. Bio-indication can be carried out at different levels of organization of living

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matter: by biochemical and physiological reactions; anatomical, morphological and behavioral abnormalities; floristic and faunal changes; biogeocenotic changes (Bio-indication..., 1988).

Improvement of bio-indication methods is aimed at revealing the mechanism of manifestation of reactions to pollution. At the same time, the features of the influence on bio-indicative reactions both from external factors in relation to the body and from the physiological processes themselves are revealed. The facts of the uneven effects of toxic substances on different organs of humans and animals, their concentration in certain tissues are well known. Therefore, the most important aspect of bio-indicative studies is to ensure the genetic homogeneity of the material a and standardization of growing conditions (Artamonov, 1986), which is poorly combined with the territorial differentiation of the results and, consequently, the possibility of their cartographic use. The total number of species and their associations used for bio-indicative purposes is hardly quantifiable. At the same time, the use of plant bio-indicators and medical statistics on the state of public health prevails. Bio-indicative observations of animals are practiced less often. For pollutometric mapping, bio-indicative data are important not so much as primary material (their capabilities are limited by low territorial differentiation), but as a final landmark.

The stability of geo-systems can be defined in relation to specific types of impacts, as their ability to accept and dissipate (neutralize, purify, bury) a certain amount of matter and energy, without losing the ability to self-reproduce. MA Glazovskaya (1988) carried out the zoning of the territory of the CIS according to the probable intensity of decomposition of techno genesis products on the basis of a complex of physical and geographical parameters. The location of areas that differ in the intensity of self-purification processes are characterized by a regular combination of zoning and sectoring. Along with general estimates of the intensity of self-purification from a complex of techno genesis products, there are special estimates for individual pollutants, in relation to geo components. Problems of mapping the sustainability of ecosystems are a consequence of the spatial ambiguity of this concept. In practice, this means that mapping should be preceded by landscape zoning, followed by a description of each landscape unit, the rank of which is determined by the scale.

Conclusion. Ecological maps, including pollutometric maps, can be subdivided into large-scale groups, which also differ in territorial coverage, purpose, sources of information and methods of displaying it (Komedchikov, Lyuty et al., 1993). Small-scale maps (smaller than 1:1000000) cover the territory of the country as a whole or large regions; their main content is the spatial localization of environmental problems, with a description of their structure and severity. Medium-scale maps (1:100000 - 1:1000000, mainly 1:200000) are drawn up within the boundaries of administrative-territorial units as educational or reference, or as graphic appendices to the Territorial Complex Schemes of Environmental Protection. In this scale group, the quantitative and qualitative characteristics of the severity of environmental problems and, in particular, pollution, are presented approximately evenly. The source of information is mainly the reporting of emissions and discharges from enterprises and cities. Large-scale maps (1:50,000 and larger) are compiled for individual areas of localization of environmental problems. In this case, the whole range of sources of information about the environmental situation is used, but pollution dispersion calculations, ecological and geochemical mapping according to the method, and mapping of concentration isolines based on stationary observations prevail.

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