INTERDISCIPLINAR COMMUNICATION AS A FUNCTION OF ENVIRONMENTAL MAPPING

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Abstract

The purpose of this paper is to consider theoretical and methodical aspects of Environment pollution mapping; to analyse peculiarities of information sources, concerning ecological situations, the ways of territorial interpretation of data and relations between pollutions of different kinds. The paper also present examples of Environmental mapping of Udmurtia. This paper is a very short version of the author's new book "Principles of Environmental mapping", printed in Russian.

1 The sources of information about ecological situations

All Environment-protection investigations or measures are carred out within concrete territories and they are impossible without spatial-uninterrupted (cartographic) information about ecological situations. This information may be obtained from 4 main sources. These information sources were elaborated within different scientific disciplines and each source claims to be universal. The most complete information about Environmental conditions, however, may be obtained through complex of information sources. The complex of sources in not identical with their, sum total, as complex approach implicates taking into account their peculiarities, advantages and limitations.

1.1 Remote Sensing

Aerial and space photographs state conditions of large territories at a single moment [1]. It is most effective for investigations of Land, Water and vegetable resources. This aspect of Environmental Mapping is most similar to traditional Geographic explorations and is well elucidated in numerous works. The opportunity of Environmental pollution mapping is smaller and concerns mainly the location of smoke plumes, dust clouds, oil films, etc., but not quantitative characteristics.

1.2 Pollution sources parameters

Owing to the Principle "pollutant pays" there appeared numerous data on emission parameters. Ecological hardware and software permit to transform this data into computer maps of calculated concentrations. The most advanced Methods [2, 3] permit to take into account meteorological conditions, relief, buildings, etc., but authenticity of results absolutely depends on emission data, so the external control is necessary.

1.3 Measuring of pollutants concentrations

It is the most reliable and expensive method of Environmental conditions owing to discreteness of each sample in time, territory and a set of ingredients.

1.4 Bioindicators

The state of bioindicator organisms is a concluding index of Environmental situation. The reactions of organisms must be definite in case of genetic and life conditions uniformity. It is difficult to ensure it in many points for mapping. So, bioindication maps are not very detailed. Sick rates may be mapped as a bioindicator too, but there are some problems arising from social factors that cannot be ignored.

2 Cartographic analysis of information about ecological situations

The Map is a single means of interdisciplinary communication, coming from the above mentioned information sources. But it should not be considered as a form for filling in with data, but a Model of complicated Nature, which contains its inner regularies and relationships. It is necessary to take into account these regularies and relationships in the Methods of Geoecological investigations on the one side and to analyse the opportunities of application of investigation results for Mapping on the other side.

2.1 Territorial interpretation of geoecological data

The conditions of pollutants transportation, deposition and deconcentration differ from one landscape to another. Landscapes as territorial units are necessary should be taken into account in cases of distribution of sampling points and interpretation of results, because "practical conclusions are concerned with territories, while scientific results are ristricted to points [4, p.167]. Landscape boundaries are important for Environmental mapping as orographic and/or geochemistric barriers for pollutants migration. Geomorphic boundaries are of most importance in case of middle-scale mapping; geobotanical ones - in case of large-scale mapping.

2.2 Analysis of pollution territorial structure

The distribution of pollution levels depends on location of sources and pecularities of transportation and deposition of pollutants. So, there are some kinds of pollution territorial structure, independent of its chemical and physical character. The kind of territorial structure may be investigated by mapping; but information about genetic regularities of territorial structure permits to predict it.

Compact structures of pollution develops in dynamic and depositing geocomponents in case of insignificant transportation of pollutants. **Plume** structure in dynamic geocomponents and **blotched** structure in depositing ones develop in the opposite case of transportation. **Concentric** structure is a result of uneven deposition during transportation in different directions. In case of the complicated structure of pollution sources the plume structure transforms into a blotched or **latticed** one.

2.3 Interdependences between different kinds of pollution and their importance for Environmental mapping

Geocomponents are divided into dynamic and depositing. The first ones (Atmosphere, Gidrosphere) are essential providing Life, but the latter ones (Soils, Snow, vegetable tissues, ground deposites) accumulate falling out, and are more suitable for mapping of pollution territorial structure [5].

There are some kinds of territorial relationships between pollution levels: between concentrations of the same pollutants in different substances (intercomponental relationships); between concentrations of different pollutants within technogenic geochemistric anomalies (interingrediental relationships); between concentrations of different pollutants in different geocomponents (intercomponental-interingrediental relationships); between pollution levels of one or some geocomponents and sick rates (geohygienic relationships). Intercomponental-interingrediental ones are of prime importance for mapping. Our research revealed the correlation between indexes of air pollution by carbon, nitrogen, sulphur oxides and dust (J) on one side and indexes of soil pollution (Z_c) by metals on the other side (correlation ratio 0,56) and also between pollution indexes of soil, snow, and air (common correlation ratio 0,72). The following equation for calculation of J indexes was received:

$$J = 3{,}466\, Z_c^{0{,}123} \tag{1}$$

$$J = \sum \left(\frac{Q_i}{M_o} \right)^r \tag{2}$$

where Q_i - mean annual concentration of pollutant number i (mg/m^3);
M_o - maximum permitted concentration of the same pollutant (mg/m^3);
r - risk estimation constant: 1,7 for pollutants of I class of toxicity; 1,3 for II class (includes NO_2); 1,0 for III class (includes SO_2 and dust); 0,9 for IV class (includes CO) [6].

$$Z_c = \sum K_c - (n-1) \tag{3}$$

$$K_c = \frac{C_i}{C_n} \tag{4}$$

where C_i - concentration of Element in the sample number i;
C_n - natural (background) concentration of the same Element;
n - number of detected Elements [5].

The equation (1) permits to map air pollution territorial structure in more details. The procedure of air-geochemistric interpretation of soil pollution data is correct for aerogenic geochemistric anomalies only.

3 Examples of Environmental mapping of Udmurtia

Udmurtia is a Republic within Russian Federation, located in the eastern part of East-Europeen Plain; 300-400 km west of the Ural mountains. The territory of Udmurtia 42,1 ths. km^2; population 1,6 mln.; capital - Izhevsk (650 ths. inhabitants). Main ecological problems are connected with pollution of air, rivers and soils by waste of steelworks, mashineworks and power plants; oil leakage during exctraction and transportation; soil erosion; degradation of forests.

Results of our research permit to analyse territorial distribution of these problems. In case of middle scale (1:200000-1:500000) mapping of the whole Republic we calculated and mapped levels of pollution of air and rivers by complex of ingredients. In case of large scale (1:25000-1:50000) mapping of Izhevsk we detected complicated, blotched and concentric structure of soil pollution and also carried out air- geochemistric interpretation of this data. We analysed meteorological conditions of air pollution by gases within separate districts. Our research also revealed the correlation between children's total sick rate (number of occasions per 1000) and Z_c indexes (r = 0,26) and J indexes (r = 0,36). So, the health of inhabitants depends on the grade of air and terrestrial pollution; but this correlation is not close.

References

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