ECOLOGICAL MONITORING OF URBAN LANDS

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Abstract: Problems of ecological monitoring of major cities are considered in the context of a citizen and environs. Three levels in problem consideration and in adopting decision on city management are distinguished.

Ecological monitoring is intended rational control of the natural and technogenic processes within the limits of urban territory. When developing the ecological monitoring of urban lands, the studies are usually focused on "negative processes". But what are the negative processes. The notion is subjective in essence, as a process is considered as "negative" from the point of view of an individual - a city dweller who estimates his environment. The townspeople often come into conflict with townsplanners and specialists about individual processes and estimation of the urban environments. In the authors opinion, a process should be considered as "negative" if it interferes with normal (established) regime of the urban life and disturbs way of peoples life. Therefore it is necessary to find sources of negative processes.

In the monitoring development, two groups of processes must be considered: a) those exerting direct impact on the state of urban land (natural, natural-technogenic and technogenic processes), b)social processes which influence appraisal of the degree of the impacts negativity. The second group includes processes related to the living standards and mode of life of the population, the degree of the social infrastructure development, the level of municipal utilities management, and the level of ecological education.

When developing structure of ecological monitoring of urban land, we proceeded from notions of "urban area" and "urban environments". The urban area, in common with any other part of the land surface, occupies a certain geographical position, and features certain characteristics of natural relief formation and a set of geomorphic processes; it is different however from any other land in that it exerts concentrated and variable effects on the environments. In response to powerful impact of a complex of technogenic factors, the urban area, in turn, becomes an essential factor which produces an appreciable effect on the atmosphere, hydrosphere, biosphere, and lithosphere, the area (and volume) subjected to the effect far exceeding the city dimensions.

In essence, the city and construction activities are a cause of "negative processes" on global scale. Other sources are both natural and technogenic components the urban environment consists of (and is controlled by). Coexisting under the same climatic and structural-tectonic conditions, the natural and technogenic components develop in close contact. various interrelations and interactions exist between them:

- natural - historical-genetic and dynamic relations between elements of geological-geographical environment,
- hydrodynamic flows - water exchange between natural and technogenic elements (components) of the urban environment, which involves rainfall, surface and ground waters and liquid wastes. The water exchange functions in a city both by natural ways (rainfall - drainage) and through hydrotechnical installations (water intake, conduits, se wage collection system and drainage),
- "engineer" relations, such as hydrodynamic flows directed by hydrotechnical constructions, and also relations between topography, hydrosphere, atmosphere and various engineer installations. A special case of engineer relations are morphodynamic relations arising between stationary (presumably) natural and technogenic elements on one hand, and various mobile and vibrating dynamic devices, on the other.

The above listed relations between natural and technogenic elements of the urban environment may be of direct and inverse character, natural objects being more often passive, while technogenic ones - active. The interactions are carried out by vertical and horizontal flows of matter, energy and information. Negative processes may arise both in the natural course of interactions and from their disturbance. Engineer connections are mostly under control, the negative processes result therefore from disturbances of their normal (planned, or foreseen) development, or "from ignorance" - due to insufficiently substantiated prognosis of the urban environment response to certain human activities, or the city dwellers reaction to a certain technogenic phenomenon or technological process.

We can demonstrate this with an example. We have studied in detail an impact of transport vibrations on the urban environment. Results of vibrometric observations carried out in the Moscow and Leningrad regions and in the cities of Moscow, Sanct-Petersbourg, Sochi, Bratislava, and others, have been analysed and compared with data cited in literature, the analysis permitted to determine characteristics of the vibration sources affecting urban environment and to identify some negative processes resulting from vibrations (when the latter reaches a certain level) (table 1) [1]. For example, due to increase in intensity of traffic streams in Moscow, especially those on roads following the

Moscow River banks, the rate of surface subsidence locally increased from 0.7 - 1.8 mm per year in 1957 to 1.5 - 3.9 mm in 1978.

Road system forms rather dense network within the city, which results in level of vibrations (46 to 60 dB) over 81% of the city area. Given the same vibration level, however, the dynamic hazard in the centre of the city is much higher (by factor of 1.5 to 3.0) than on the outskirts. This is due to the fact that in the centre technogenic deposits form a continuous mantle more than 3 m thick (locally up to 10-20 m), and the technogenic deposits' resistance to vibratory load is much lower as compared with that of natural grounds.

Table 1 : Limits of vibrational impact

Vibrational level (10^{-3} m/s)	Vibrational impact after-effects
0.1	Tolerable vibration in residential buildings at night
0.2	Tolerable vibration in non-residential buildings and in residential ones in the day time
1.2	Slight damage to old buildings and architectural monuments (peeling of lime-paint, falling away of small pies of plaster etc.) are possible
3.0	Top value for buildings which are especially sensitive or worthy of protection
5.0	p value for buildings with wooden floors
8.0	Top value for buildings with masonry walls and concrete floors
12.0	Top value for industrial and office buildings in reinforced concrete
16.0*	Complete compaction of dry sands is possible (without static load)
80.0*	Complete compaction of water saturated sands is possible (without static load)
115.0*	Complete failure of the structure of dispersed ground is possible

* Measured on samples.

Every "negative process" in the territory of a city is characterized by the time and space parameters. These characteristics of processes also determine the zone of observations - the monitoring zone.

The setting up the ecological monitoring, relative to the state of lands, it is necessary to create a data base, cartographic including, which should consist of three blocks, corresponding to the level of the consideration of problems and taking decisions in the field of urban management.

The 1st level - federal. This level pertains to long-term forecasting of the relationship of the city with adjacent territories. The scale of investigations is 1: 200 000 - 1: 100 000.

The 2nd level - urban. This level refers to strategic policies in the present-day urban territory. The scale of investigations 1: 50 000 - 1: 25 000. The set of maps should include physico-geographical maps, engineering geology and hydrogeological maps, as well as integrated territory assessment maps.

Table 2 : Ecological-geomorphological characteristics of some drainage basins within the limits of Moscow.

Basins	Characteristics*					
	1	2	3	4	5	6
Yauza, upper reaches	109.2	0	30	3	0.30	0.6-1.2
Yausa, lower reaches	415.8	14	30-50	3-6	0.40	0.7-2.6
Setun, upper reaches	89.7	0	30	3	0.36	<1
Setun, lower reaches	133.6	10	30-50	3-6	0.40	<1.8
Presnya	15.3	100	50	6-10	0.55	1.6-1.9
Neglinka	14.7	100	50-80	6-10	0.75	1.8-3.4
Krovyanka	15.7	70	50	<20	0.50	1.8-3.4
Khodynka	19.5	100	50	<20	0.54	3.4-4.4
Kotlovka	18.4	11	50	6	0.50	1.8-3.4
Chertanovka	42.7	11	30	3	0.39	<1
Gravoronka	93.0	16	30-50	3-6	0.44	1.6-1.9

* Characteristics: 1 - the basin area, sq km; 2 - coefficient of drainage density change (%); 3 - housing density; 4 - thickness of technogenic deposits, m; 5 - surficial runoff coefficient; 6 - average rate of the land surface subsidence, mm per year.

The 3rd level - local. The level refers to tactic decisions on regional and microdistrict planning, which is the basic land monitoring. The level includes regime observations and modeling (natural and mathematics). In this level the concrete information is needed on the structure of land management, on the present state of the environmental elements. The scale of investigations 1: 5 000 - 1: 2 000.

Urban land monitoring network may be developed within the frame of elementary drainage basins. Water exchange, as well as studied within a drainage basin. The results would allow to conclude on the degree to which individual components of urban environment have been subjected to changes, and on the probability of "negative processes" manifestations. As an example, see table 2 [2].

The decisions taken on a local scale should agree with the recommendations, worked out on a regional and federal levels. Only in this case we can approach the settling of the main problem in city designing and building - a wise urban land utilization with due regard for ecological requirements

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References.

[1]. Lokshin, Gregory; Chesnokova , Irina. Highways and some ecological problems of urban areas Bulletin of IAEG, 1993, N 47, pp. 119-125.

[2]. Likhacheva, E.A.; Smirnova, E.B. "Environmental problems of Moscow during the lest 150 years". Moscow, 1994.