Kuitun, Nizhne-Udinsk and Taishet regions. Carcareous soils are mainly located in Ust-Orda Buryat region, Bratsk, Kachug and Ust-Udinsk regions, they are very fertile. Soddy podzolic soils are located in taiga and subtaiga zones that are characterized with low fertile and are rarely used in agriculture. Chernozems are highly fertile soils with large content of humus; they are located in steppe and forest-steppe regions [1].

Effective functioning of the whole nature protection activities system is impossible without geoinformational systems (GIS) that allow monitoring, processing and analyzing the data, damage evaluation etc. At present there are a few of GIS in Irkutsk region, such as "Baikal" and "Irkutsk region". In the ecological subprogram of GIS "Irkutsk region" the different map making method is developed, i.g. population disease, atmosphere, water and soils pollution. Basing on that data a complex medical-ecological map of the south part of Irkutsk region is made.

Unfortunately, instable economics and insufficient technical and financial means do not allow carrying out the activities targeted to restore soils. There are also no reliable methods that allow to adequately evaluate and predict the consequences of different influences on the soils taking into account its spreading on the surrounding areas.

The Irkutsk regional office on hydrometeorology and environment monitoring observes soils pollution near the industrial cities of Irkutsk region. They define the following toxins: lead, manganese, chrome, nickel, molybdenum, tin, vanadium, copper, zinc, mercury, cobalt, sulfates, and measure pH in the soils. They observe the atmospheric sediments, snow cover and soils fluorides pollution. They inspect soils to define oil products and pesticides.

The criteria of soils pollution is the highest permissible concentration (HPC) of a pollutant. If there are no HPC defined, the pollution level is compared with ambient level or with soils clarkes. Clarke is the percentage of a chemical element in the Earth crust named after F.U. Clarke.

The technogenic soils pollution is at highest level near the industrial enterprises, big cities and roads. The main sources of soils pollution are gas-and-dust emissions sedimentation and sewage dumps. Besides, heat energy enterprises are the sources of ash dumps. On 10.01.2000 there were 26.759 hectares of breached lands in Irkutsk region. These negative activities are anthropogenic, and they result in soils degradation and total lands pollution.

Analyzing the soils pollution data for the period of 10-15 years we can't evaluate the real ecological-economical damage to the Irkutsk region soils. The modern ecological activity does not pay attention to pollution spreading and to the interference between different pollution types. Though there are many methods to evaluate the ecological damage to soils, atmosphere and water, unfortunately, they are not appropriate because they don't take into account the physical properties of time: time density – the rate of space organization, and time pace – the speed of transforming a cause into a consequence.

We suggest to apply the new author's method [2] of ecological-economical damage evaluation. The formula of the method is:

$$Ev = \frac{C_{dam} \cdot S_{dam}}{100 \cdot S_{gen}^{n}} \cdot R_{com} \cdot T_{\max} \cdot \left(\frac{1}{Sc}\right)^{n-1},$$

where Sdam – breached lands area; Cdam – breach rate; Sgen – total area of a level; Rcom – the number of breached relations in natural system; Tmax – component's life time; Sc – scaling factor; n – level number.

Replacing the Cdam by HPC we obtain the formula for soils damage evaluation:

$$Ev = \frac{HPC \cdot S_{dam}}{S_{gen}^{n}} \cdot R_{com} \cdot T_{\max} \cdot \left(\frac{1}{Sc}\right)^{n-1}$$

Thus, changing the formula, we can also evaluate water and atmosphere damage. After that we can evaluate the complex environmental damage and define the interference areas. This will promote the harmonious exploitation and, accordingly, the preservation of a mankind.

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The work was submitted to international scientific conference conference "Human and noosphere", scientific heritage of Vernadsky V.I., Global problems of present-day civilization», UAE (Dubai), October 15-22, 2008. Came to the editorial office on 19.08.2008.

THE TIME-SPACE METHOD OF ECOLOGICAL DAMAGE EVALUATION

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In view of high anthropogenic pressure on environment the new approach of complex ecological territory evaluation should be found. Surrounding spaces are multi-sided, and mankind influences on the environment at local, regional and global levels. Frequently something that is useful for a group of people is harmful for the environment. And the environment is a dynamic system that has many external and internal factors.

The Federal ecologic, technologic and nuclear inspection service's board resolution dated 02.04.08 states the following. During the last decades intensive

industrialization and extensive natural resources exploitation took place in Russian Federation. That caused great negative environmental impact and accumulating pollution in different environmental components ("ecological damage") which is concerned with using old technologies.

When developing market economics that leads to large-scaled privatization and industrial producing decrease (first of all in military and chemical industry) in the 90-th, a significant amount of mismanagement and economically unattractive actives appeared, which are characterized with high risk level for environment and human health, as well as for the territories close to ecological crisis. The most influence in the social sphere is observed in those territories of environmental impact, which are located within populated and industrial areas (they have direct affect on the health of more than 60 billion Russian people, who live in the cities and work on the factories).

The complex environmental impact evaluation that is accumulated in Russian Federation as a result of economic activity was not carried out yet, and present data are fragmental. In particular, RusTechInspectation carried out environmental impact investigations in Kemerov and Irkutsk regions targeted on making suggestions on environmental impact elimination and polluted territories restoration.

Russian legislation does not define what is "environmental impact", "ecological damage"; does not regulate the questions concerned with responsibility for environmental impact caused during the past economic activity. There are no methods of recognition, registration and evaluating "ecological damage" concerned with economic activity. The mechanisms of financing the "ecological damage" elimination activities are not worked, as well as polluted territories restoration on the base of state-private partnerships.

Thus there is a necessity for developing and applying the complex of activities on ecological damage elimination, including polluted territories restoration, taking into account international experience and the detailed investigation of accumulated ecological damage problem. There is a necessity for founding and working juridical and investment mechanisms of environmental impact elimination.

Existing damage evaluating methods don't take into account the spreading of environmental impact on higher hierarchical system levels. Thus, in spite of their significance, they can't give a correct damage evaluation. Most researchers agree that natural systems have complex multi-level structure, but they use the category of time incorrectly. There is a necessity to deeply analyze the time in view of astrophysicist Kozyrev's time theory. According to this theory time possesses the following physical properties:

- Direction – time is directed from cause to consequence; we cannot change the order of cause and consequence.
- Pace – there is a time (Δt) and a space (Δx) distance between cause and consequence. $C2 = \frac{\Delta x}{\Delta t}$ is a time pace, the speed of transferring cause into consequence. The more C2, the faster time goes. Time does not have an impulse but it gives additional power and rotation moment to a system.
- Density – organizes a system and reduces entropy. The more entropy, the larger time density. It also can be reduced by a special sheet or increased by parabolic mirrors (Kozyrev's mirrors).
- Holonomity – as time has no impulse, it appears everywhere at the same time.
- Data storage – the processes that lead to the entropy increase reorder the structure of surrounding matter.
- Asimmetricity – having a certain asimmetricity an organism obtains additional viability.

Thus, taking into account the structure of time adequate to the structure of space, we can conclude that environmental impact will breach all natural system's levels but in different rates. Thus, we should develop a new damage evaluating technology basing on the time-space ecologic-economical damage evaluating method.

It is a paradox that there is no time theory in physics yet, though there is space theory – geometry. More than 3000 years ago people knew how to use the categories of lines, plane and volume. Geometry as a science was founded by Euclid in III BC. And still physicists use geometrical views trying to open the secret of time.

Calendar time does not always show the qualitative changes that occur during different life cycle stages of a system. It defines only quantitative time intervals – the duration (second, minute, hour, day, month, etc.), and doesn't take into account energy potential changes that only physical time can define. External influences on a certain material system (natural or anthropogenic) slow down or speed up its internal processes. Even more, they can lead it to extremely instable condition and change the system. However, those influences can't change the development program that is put in a certain system by the time pace of the system of a higher level.

The world is constantly changing, and everything happens in the time. The time is inseparable from everything in the world. Physical laws exist in the time, energy saving is a consequence of some time's properties. Obviously, the causality principle should be a science foundation. Physical sense and mathematical expression of time pace (the time of transition of cause into consequence) can be derived from the time-space causality properties. We can't objectively evaluate the environmental impact consequences without understanding the role of time pace and time density.

With every hierarchical level the resolution ability of a system is growing because the time "flows" more slowly with level increase. Human activities change both time pace and time density. It is hard to evaluate the risks and breach boundaries (where the system can't restore itself) without the time-space model that takes into account the physical properties of time when evaluating the state of the environment. The highest level of environmental impact is on the local object. With level increase it slowly decreases.

Using the time-space model of ecologic-economical damage evaluation we can evaluate the lands breach as follows:

$$Ev = \frac{C_{dam} \cdot S_{dam}}{100 \cdot S_{gen}^{n}} \cdot R_{com} \cdot T_{\max} \cdot \left(\frac{1}{Sc}\right)^{n-1},$$

where Sdam – breached lands area; Cdam – breach rate; Sgen – total area of a level; Rcom – the number of breached relations in natural system; Tmax – component's life time; Sc – scaling factor; n – level number.

This formula is an expression of time density, $T_{\max} \cdot \left(\frac{1}{Sc}\right)^{n-1}$ and the ratio is time pace. To evaluate the damage to another component (e.g. atmosphere or water) one should simply replace area with appropriate parameter.

Using this ecologic-economical damage evaluation formula we can define the breach boundaries and specified environment restoration activities to prevent the natural system from degradation. Besides, this method allows defining the areas of environmental impacts imposing (interference) and evaluating the summary environmental impact damage in these areas.

It is obviously that the damage within interference areas is quite high though the origin is quite far from them. These areas are the areas of high risk along with the local objects in the center of the circles. That's why we should define buffers (or ecological barriers) between industrial zones and between different industries within those zones to prevent the natural system degradation. Our method allows to do that and it should be used at any level – from a small town to a whole planet.

Replacing the Cdam by HPC (the highest permissible concentration) we obtain the formula for soils damage evaluation:

$$Ev = \frac{HPC \cdot S_{dam}}{S_{gen}^{n}} \cdot R_{com} \cdot T_{\max} \cdot \left(\frac{1}{Sc}\right)^{n-1}$$

Replacing the areas by the volumes, we obtain the formula for water resources damage evaluation:

$$Ev = \frac{HPC \cdot V_{dam}}{V_{gen}^{n}} \cdot R_{com} \cdot T_{\max} \cdot \left(\frac{1}{Sc}\right)^{n-1}$$

But in this case we must take into account the spreading of pollutants in the water. In the stationary basins we can neglect the dynamics as the formula itself takes into account the spreading of damage on surrounding areas. As for the rivers, we can estimate the limits of pollution by adding the following formula:

$$L = v \cdot t,$$

where L – a distance that the pollutant will get over going down the river; t – the time of pollutant's dissolution; v – the average speed of the river. Thus, the local influence is not a "point", as in the case of soils, but a polyline with the length of L.

Pollution spreading registration, along with damage evaluating within different hierarchical levels of a system, defining the areas of different damages interference – are a complex of tasks, which solution takes much time and forces. Thus there is a necessity to develop specialized technical means.

We developed a program product for evaluating soils damage. It includes the following functions:

- data storage for different pollutants since 1993 to 2004;
- graphical visualization of spreading, interference and combination of different pollution kind within Irkutsk region;
- defining the areas of interference and evaluating the damage within those areas;
- analyzing the evaluated damage;
- predicting the environmental impact within investigated region;
- graphical visualization of every pollutant's affect in different years and each city of Irkutsk region;
- ordering data by different parameters;
- searching the data within data base.

We are planning to develop a program product "WaterRisk" with following functions:

- pollution data storage;
- rules describing some point of author's method application, in particular, how to define the minimal radius of pollution basing on the its density;
- defining the areas of different damages interference;
- damage evaluation;
- graphical visualization of spreading and intensity of pollution;
- analyzing the evaluated damage;
- predicting the environmental impact within investigated region;
- data storage for the program results.

All these activities are targeted to the harmonious exploitation and, accordingly, the preservation of a mankind.

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