

## Monitoring of factors of ecological safety of urbanized territories' population (by example of settlements of Voronezh Region)

Sergey Alexandrovich Yeprintsev, Semyon Alexandrovich Kurolap, Igor Vladimirovich Komov, Ivan Vasil'yevich Minnikov

Voronezh State University, Universitetskaya ploshchad', 1, 394006, Voronezh, Russia

**Abstract.** In Voronezh region there were analysed factors determining ecological safety of territory's population. Using stationary and mobile sources in different parts of the Voronezh region, atmospheric pollution has been studied on the basis of long-term observations. The degree of the soil contamination as an indicator of environmental quality has been evaluated. The cadastre of objects of ecological risk has been compiled. Using GIS technologies a comprehensive zoning of the Voronezh region has been done according to the level of geochemical pollution of natural environments. The zones of ecological and geochemical anomalies have been revealed. The specific contribution of different factors in the formation of integral value of population ecological safety has been defined.

[Yeprintsev S.A., Kurolap S.A., Komov I.V., Minnikov I.V. **Monitoring of factors of ecological safety of urbanized territories' population (by example of settlements of Voronezh Region)**. *Life Sci J* 2013;10(12s):846-848]. (ISSN:1097-8135). <http://www.lifesciencesite.com>. 136

**Keywords:** Monitoring factors of ecological safety, environmental risk, urbanized areas, pollution of the atmosphere and soil.

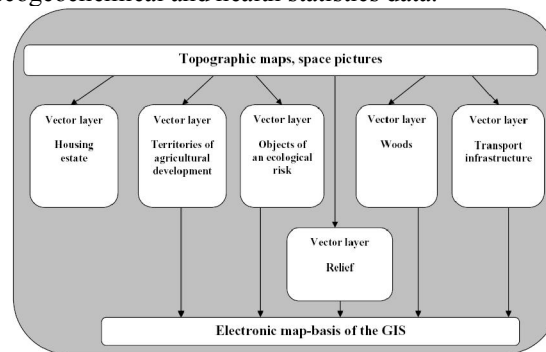
### 1. Introduction

Environmental safety issues are becoming more actual every year [1-4]. Urbanization, industrialization, technological progress essentially improve quality of life but at the same time there is a growth of several attendant problems one of which is the increase of level of environmental pollution. Increase of anthropogenic pollutants in the environment on the territory of many big cities directly or indirectly produces environmentally caused diseases of population. This fact makes actual constant monitoring of factors determining ecological safety of population [5-9].

For monitoring of factors of ecological safety of the population of the Voronezh region GIS "Ecogeochemistry and technological hazards of the Voronezh region" was created. The electronic ecological atlas of the Voronezh region has been created by means of this GIS. As the basis of GIS is an automated database "Ecogeochemistry of Voronezh region", as well as software and mapping tools for creating geo-ecological maps of the city of Voronezh. As a basis of database "Ecogeochemistry of city of Voronezh region" are long-term observations (from 1996 to 2013) for geochemical state of environment of the territory of the region – atmosphere and soil pollution on priority pollutants in various points.

For systematization of data on a state of environment and studying of formation of zones of an ecological risk for the population of the Voronezh region we've used the MapInfo Professional programme which is most convenient for goal

realization. Using this program, an electronic map-base of GIS of Voronezh city has been created. The structure of this map is shown in Figure 1. The resulting electronic map-base in GIS MapInfo was the basis for the spatial mapping and analysis of ecogeochemical and health statistics data.



**Figure 1 – Structure of the electronic map-basis of the GIS "Ecogeochemistry and technological risks of the Voronezh Region"**

Voronezh region is the industrial - agrarian region, located in the centre of the European part of Russia. Area - 52,2 thousand sq. km. (doubled territory of Macedonia; 0.3% of the territory of the Russian Federation and 8% of Central Federal Region). Population - 2,334,8 million (a little more than in Latvia; 1.6% of the population of Russia and 6,2% of the population of Central Federal Region) [10]. The population of the region is a densely populated area: population density is 43.5 people/sq. km (the average in Russia - 8,3 people/sq. km; in

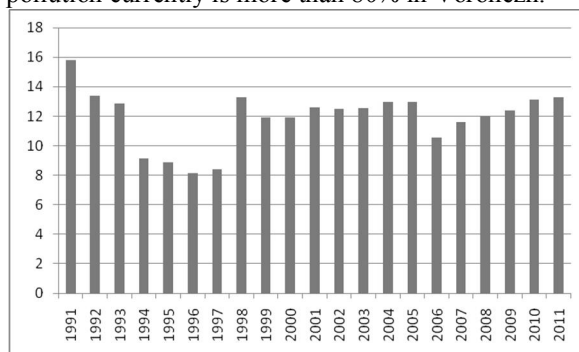
Central Federal Region - 57,1 people/sq. km). The share of urban residents in the total population of the region is 63,3%. The share of rural population is much higher than the average in Russia and Central Federal district: 36,7% against 26,9% in the Russian Federation and 19,3% in the district. The proportion of the economically active population is about 50% [10]. Voronezh region is one of the biggest industrial centres of Russia where are concentrated manufactures of a wide spectrum of high – tech industrial products – from aircraft and rocket engines to rubber and mineral fertilizers. Nowadays the share of region in Russian manufacture of rubber is 20%, electric power produced by nuclear power plants – 9%, motor vehicle tires – 8,4%, fractional motors – 18,6%, mineral fertilizers – 3,8%. In total there are 260 large and medium industrial enterprises where more than 142 thousand people work.

The main industrial manufactures of ecological risk are Open Joint-Stock Company «Voronezh Aircraft Joint-Stock Company» which is a part of United Aircraft Corporation producing Airbus Il-96, Joint-Stock Company «Voronezhsintezkauchuk» (produces high-quality synthetic rubbers, latexes and thermoelastolayer), Joint-Stock Company «Minudobrenia» (the only manufacturer of mineral fertilizers in Central Chernozom Region), Joint-Stock Company «Pavlovskgranit» (the largest in Europe enterprise on extraction and production of non-metallic materials), Joint-Stock Company «Voronezh tyre plant» (manufactures tires for trucks, cars, road construction machines, motorcycles and agricultural machinery), 2050 organizations of construction complex; more than 300 enterprises of building industry, Novovoronezh NPP and others.

Analysis of total value of emissions of polluting substances into the atmosphere from stationary and mobile sources for a long-term period shows constantly changing dynamics of this indicator in Voronezh region (figure 2). In the end of XX century there was a tendency of decrease in emissions of pollutants. This fact is connected with long economic crisis, bankruptcy, liquidation of many enterprises.

Since 1998 this indicator has been increasing to 1000 t. per year. The highest values of this indicator are on the territory of Voronezh. In XX century the main sources of emissions of polluting substances into the environment of Voronezh are industrial enterprises. At the end of XX century due to the social-economic situation of the country industrial potential of the city essentially decreased what caused reduction of emissions of polluting substances into the environment. At the beginning of XXI century the industrial potential of the city restored, however, due to toughening of environmental legislation high technologies

minimizing the negative impact on the environment are applied into production cycle of the majority of industrial enterprises. At the same time growth of common weal led to essential growth in quantity of cars. Thruways in Voronezh as well as in other big cities were designed in XX century for less traffic which increase causes number of traffic jams and the operation of the motors at a lower gear what pollute environment much more. Thus, specific contribution of mobile sources in the integrated indicator of pollution currently is more than 80% in Voronezh.



**Figure 2 – Total value of emissions of pollutants from stationary and mobile sources in Voronezh region (vertical - the amount of emissions, tonnes/year; horizontal - years)**

Moreover, the highest total value of emissions of pollutants from stationary and mobile sources of pollution in Voronezh region is in Rossoshanskiy district (the main source of pollution of environment is JTC «Minudobrenia»), Kalacheevskiy and Liskinskiy districts (the main sources of pollution are industrial plants and transport complex). In the above districts total value of emissions of pollutants into the environment is essentially lower than in Voronezh.

The lowest value of emissions of pollutants from stationary and mobile sources in Voronezh region is in Vorobiyovskiy, Verkhnekhavskiy, Petropavlovskiy and Ramonskiy districts – agrarian and recreation zones.

There was examined the content of carbon dioxide, nitrogen dioxide, dust, lead, phenol, sulphur dioxide, formaldehyde in the atmosphere for a complex study of air pollution based on data of own ecological and geochemical studies, statistical information for a long-term period of Centre of Hygiene and Epidemiology in Voronezh region.

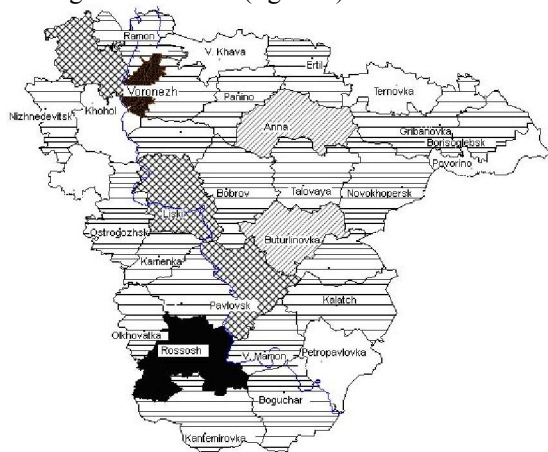
These data show the presence of maximum permissible concentrations in a number of settlements (figure 3). The largest number of unsatisfactory samples during analysis of air pollution is in Voronezh where the fields of anthropogenic pollution of the atmosphere are formed by a transport complex, industry and heat-power plants. Microclimatic

conditions and the relief of the territory make an additional contribution to zones of geochemical anomalies. For example, the largest air pollution made by a number of anthropogenic pollutants is observed in Transportnaya Street, located in lowland with bad aeration.

Large value of unsatisfactory analyses of air pollution is in settlements of Rossoshanskiy district (figure 3) where the main source of pollution is JSC “Minudobrenia”. However, since beginning of XXI century this indicator decreases annually that shows competent ecological policy and optimization of production cycles at the plant.

Also a high percentage of unsatisfactory analyses of air pollution is in Liskinskiy and Pavlovskiy districts of Voronezh region. The main sources of air pollution in Liskinskiy district are industrial plants and transport complex (a section of one of the most loaded highways in Russia – M4). Air pollution of Pavlovskiy district is caused by JSC “Pavlovskgranit” specialised in granite extraction and production of granite macadam.

The lowest value of air pollution is in Ternovskiy, Petropavlovskiy, Verkhnekhavskiy and other agrarian districts (figure 3).



**Figure 3 – Ratio of unsatisfactory analyses of air pollution in settlements of Voronezh region over a long - term period (1995-2012)**

The content of anthropogenic pollutants in the top-soil (oil products, total and mobile forms of heavy metals - cadmium, manganese, copper, nickel, lead, chromium and zinc) was examined to estimate general tendency of ecological safety in Voronezh region. Unlike the atmosphere soil keeps anthropogenic pollutants for a long period that let estimate long-term ecological situation in the analysed region.

12/22/2013

These data of top-soil pollution is not different from geochemical fields of air pollution, however, on several territories (Kantemirovskiy, Podgorenskiy, Anninskiy, Ertiliskiy and other districts) where are not observed essential atmosphere anomalies but high content of heavy metals in soil. This fact shows an intensive impact on land resources of this territory in XX century as well as transfrontier transport of heavy metals away from remote objects of environmental risk.

Thus, monitoring of factors of ecological safety of urbanized territories' population show that anthropogenic pollution of this territory is within the average Russian level. The most negative situation is on the territory of Voronezh, Rossosh, Liski, Pavlovsk and other settlements. These territories can be classified as zones of environmental risk. The main source of air pollution in Voronezh is a transport complex. On other territories they are industrial plants.

This article was prepared under a grant from the Russian Foundation for Basic Research # 12-06-33017 mol\_a\_ved.

#### Corresponding Author:

Dr. Yeprintsev,  
Voronezh State University, Universitetskaya  
ploshchad', 1, 394006, Voronezh, Russia

#### References

- Juvelikyan H.A., 1996. Ecology, city, man. Voronezh, pp: 104.
- Yeprintsev S.A., 2009. Assessing of the impact of urban sprawl and air pollution on the health of the population of Voronezh City. Bulletin of Tambov University. Series of natural and technical sciences, 14(3) : 600-604.
- Yeprintsev S.A., 2009. Assessing of environmental risk of urban areas with using GIS – technologies. Environmental Systems and Devices, #2: 3-8.
- Kurolap S.A., 2010. Voronezh: habitat areas and ecological risk. Publisher «Istoki», pp: 207
- Lackey, Robert T. 1994. Ecological risk assessment. Fisheries, Bulletin of the American Fisheries Society. 19(9): 14 - 18.
- Lackey, Robert T. 1997. Is ecological risk assessment useful for resolving complex ecological problems? In: Pacific Salmon and Their Ecosystems: Status and Future Options. Deanna J. Stouder, Peter A. Bisson, and Robert J. Naiman, Editors, Chapman and Hall, Publishers. pp. 525 - 540.
- Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. New York, NY: Reinhold.
- Green, R. H. 1979. Sampling Design and Statistical Methods for Environmental Biologists. New York, NY: Wiley.
- Ott, W.R. 1995. Environmental Statistics and Data Analysis. Boca Raton, FL: CRC Press, Inc., Lewis Publishers.
- Economy of Voronezh region. <http://www.govrn.ru>.