

Space photodata for ecologic maps generation

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The problem of ecologic mapping for nature protection, rational use and recuperation of natural resources is the most actual world-wide problem of today. One of the main method which is used for elaboration of the ecologic maps is the Earth remote sensing from space, as the specific method is the most quick and reliable for collection of uniform-time data of the environment and ecologic situation over large territories. The ecologic studies, accompanied by the creation of the ecological maps on the base of the space photo materials, were carried out in the different regions of Russia. Particular results of these works are reflected in this paper.

Increasing scales of interaction of nature and person are resulted in unreasonable exploitation of natural resources, man-caused violations and industrial pollutions of natural environment, it causes an ecosystems degradation and essential changes in natural complexes. It results, for example, in territory desertification and other destructive consequences. The unfavorable natural processes (landslides, mudflows, tsunami etc.), causing to violation or even to breaking down of landscape structure, influence besides considerably on natural environment.

The major task of mankind is a possibility of regulation of its relationships with nature, rational use of nature and its protection realized as preventing of damages and undesirable consequences of person interference, forecasting of possible changes of all complex of the phenomena and directing of the development along the wishful way. In composite relationships of nature and person it is important to analyze and forecast not only clearly visible immediate economic objects influences on nature with taking into account of today and proximate outlooks necessities, but also more distant influences both in time, and in room. That's why ecological aspects of a territorial organization of society are required in its structure and dynamics simulation by cartography facilities.

The objects, influencing sharply negatively on environment, ecological situation, the population health condition (nuclear power plants, nuclear polygons, oil pipelines, chemical plants etc.), are required of special attention. The main problem in a number of ecological ones having priority-driven national significance, is the poor data support of ecological actions. The absence or deficiency of the necessary information does not allow to judge about a natural environment conditions, scales and extent of its pollution, ecological repercussions of man-caused and natural origin, and also to do a social and economical estimation of the natural resource potential use for concrete territories.

The Russian territory extensiveness is required of the use of methods permitting to obtain data about an ecological situation simultaneously for vast territories. Remote sensing of the Earth from space is one of the most operating and objective methods of data acquisition about natural environment. Perhaps, any other method could not give the detail spatial information about ecological condition of vast territories. The space information has a major role for compiling ecological maps, revelation of ecological situation types, arrangement and conducting of ecological expertise, justification of the ecological prognosis models and ecological hazard estimation at conducting these or other economic actions.

The problem of ecologic mapping for nature protection, rational use and recuperation of natural resources is the most actual world-wide problem of today. Ecologic maps are used for the enhancement of different ecologic problems connected with the evaluation of ecological situation assessment and their influence over economic factors, creation of the base for local G.I.S. of ecologic trend, support for ecologic monitoring, generation of forecast models specifically for accident cases. The ecologic maps will generate a picture how ecologic systems work under the influence of a man on the environment, and will contain the forecast elements aside with the recommendation how to improve the ecologic situation.

One of the main methods which is used for elaboration of the ecologic maps is the Earth remote sensing from space, as the specific method is the most quick and reliable for collection of uniform-time data of the environment and ecologic situation over large territories. The application of space data must be directed to detect and establish ecologically important factors of pollution of nature, their sources and the results of ecologic problems. The space images, acquired from Russian satellites, unmanned space vehicles of "Kosmos" series, as well as from manned spacecraft and long-life orbital platforms, correspond to these purposes. In Russia there was formed an integral nature monitoring system which is operatively used. The system is called "Resource" and involves the photoobservation satellites "Resource-F", satellites of operative sensing "Resource-O", auxiliary space vehicles (manned orbital platforms, experimental space satellites, double purpose spacecraft), experimental test sites, aircraft and helicopters.

There is a sufficient scientific and technical resource in State center "Priroda" on ecological mapping and space information use for cartographical ensuring of measures for an environment protection. The actions are carried in it more than 20 years on complex study and map-making of natural resources and ecological conditions on the base of space shooting materials. The received maps are used for a solution of perspective natural-resource and ecological problems at the moment of territorial planning, designing and for purposes of the prognosis of territory progress.

The serial of ecological and cartographical actions is performed according to order of the "Roskartografiya" department, during which the basic principles of ecological mapping are determined, the project of the Russian Federation ecological safety concept is developed, the leading technical materials for complex ecological mapping (including the forecasting mapping) on the basis of the space photoinformation are proposed. The developed methods and technologies were realized at map compiling for areas of allocation of objects, the action of which influences on ecological safety of country (districts of oil-and-gas production in Western Siberia, East-Ural radioactive trail etc.), for revelation of ecological repercussions of war actions and ecological conditions of troop basing areas. The maps of an ecological contents for a number of regions of country and large districts of oil-and-gas production are drawn up, the methodical guidelines for ecological maps creation are designed and the vast material about natural environment violations, fixed from space snapshots, is collected.

The principally new approaches to mapping of ecological safety of Russia and ecological mapping, including particularly dangerous objects, are designed as a result of the fulfillment of actions, the possibilities of use for these purposes of space shootings materials, increasing of objectivity, reliability and efficiency of ecological maps creation are shown. The designed methods can be in future used for preventing or decrease of ecological damage on the basis of international cooperation with taking into account of possibilities of transboundary transport of the contaminating substances and threat of global ecological catastrophe rise.

The great fund (more than 2 million photos) of space photos of past years is accumulated now in the State center "Priroda", which is permitted to develop the methods of using of these data for ecological aims, to study the dynamics of ecologic state of region, to use them for the prognoses and composition of the ecologic maps.

The space photos as themselves without using the data of ground net of observations could not give the full information about the pollution and violation of the environment. The authenticity of creation of complex ecologic maps could be guaranteed only with the joint using of the materials of the space survey and the information, received by the ground means of observation. The using of the space information in the aims of the ecologic cartography, first of all, should be aimed at revelation and the establishment of the ecologically important factors of natural environment, the anthropogenic violations and pollution of the natural environment and their sources, the after-effects of the ecologic violations. The collected materials may be used for determination of the ecological state of the natural environment – of the integral index of the violations and pollution of nature, exerting the unfavorable influence on the vital activity of the human being, animals and plants. The elaborated information is used for the creation of the ecologic maps.

The works are carried out for 20 years on complex study and cartography of the natural resources and the ecologic conditions on the base of the space photodata. The space photos of different kind and scale were used as the basic sources for the creation of ecologic maps and other cartographic materials were added too. The maps, created as a result of these works, were taken into account at the solution of the perspective nature-resource and ecologic problems. The cartographic material is necessary for the preparation and the acceptance well-grounded decisions in the area of territorial planning, design, administration and prognosis of the development of territory. These sets of maps were created for the territories of Calmykiya, regions of Tver' and Stavropol', North Baikal, Tajikistan, Uzbekistan and other regions. The works on complex study and cartography of the natural resources and the ecologic conditions of the certain areas are continuing and now. The sets of maps are creating for the territories of a number of subjects of the Russian Federation. A number of the methodological recommendations, which are described the processes of the creation of the ecologic maps from the development of the author models to their working up, are elaborated.

The ecologic studies, accompanied by the working up of the ecological maps on the base of the space photo materials, were carried out in the regions of the oil and gas mining in West Siberia, the East-Urals radioactive trace, in the areas of deserts of Kalmykia, in the regions of mining of the copper-nickel ores and coal in Krasnoyarsk area and so on.

The powerful anthropogenic pressing was taken place on the north of West Siberia because of the mining of the different sorts of the hydrocarbon raw materials (oil, gas, condensate). The frail northern nature with its taiga, tundra, bogs, long-term frozen lands could not stand such great loading. As a result of it the great areas were transgressed and contaminated: the forests were cut down, relief was reformed, lands, lakes, rivers were contaminated by the petroleum products and the boring solutions, the thermal regime of the long-termed frozen lands was disturbed, the ecologic conditions of the animal life were changed. The damage was caused in many places to the traditional economy of the northern people: hunting, fishery, deer farming.

The ecologic maps of some deposits were created on the base of the results of the space photo deciphering. There are shown the basic natural complexes, the objects of oil-mining, the degree of the anthropogenic violation is estimated. The space photodata and the ecologic maps are permitted to give the recommendations for the razionalization of the natural using and the decreasing of the damage, caused by the oil-mining activity.

The East-Urals radioactive trace was formed as a result of an accident on the industrial complex "Mayak (lighthouse)" (Chelyabinsk region) in 1957 and extended along the Techa-river into Chelyabinsk, Sverdlovsk and Tyumen' regions. It is impossible to see the radioactive contamination from the space. But the thematic deciphering of the photos and the using of the results of the ground observations let to do a prognosis and to create a map of expansion of the radionuclides along the territory.

The Republic of Kalmykiya, which is situated in the south of European part of Russia, is a region of the ecologic disaster. The intensive pasture of sheep, the ploughing up of the weak-consolidated sandy lands, the melioration of lands were resulted to the broadening of the area, lacking of vegetation, to the advance of sands on the developed by a human being parts, to the second salting of the earth and, as a result of it, to the formation of the desert on this territory. The situation in Kalmykiya is aggravated by the fact that its eastern part is flooded now because of lift of the level of the Caspian sea. There is a critical situation in Lagan' town, it is necessary to build the defense barrages, the constructions for leaking of water and other objects. Kalmykiya was one of the first regions of the country, where the works were intensively conducted on the using of the space information for the solution of the natural, resource and ecologic problems. As a result of the deciphering of the photos from the satellites the set of map was created and published in scales of 1:1000000 and 1:500000, which is included the geological map, tectonic one, the map of the perspectives of the gas content, the soil map, the vegetation map, the map of the using of soils, the landscape map and the other ones.

The quickness is the most important factor for the generation of ecologic maps. The advances technology of computer progress allows to quickly generate digital ecologic maps with the use of interpretation of space photoes, topographic and thematic maps, data of land observation. The thematic layers which characterise the actual state of the environment are positioned over the standard geographic background. The work includes scanning of the map original, vectorization by thematic layers, conversion of files to uniform co-ordinated system, editing of files (by colours and line types), map content elements symbolization, CD-ROM or diskettes recording. If needed the map can be printed on paper in any time.

The quick creation of ecologic maps will contribute to its integration on uniform system of ecologic monitoring of Russia.

The techniques and the technologies for creation of ecological maps, developed by us on the basis of space photoinformation usage, were applied for mapping of territories for a number gas and oil deposits of the north of Western Siberia, prepared to development and operation.

The methods of the creation of the different ecologic maps were developed as a result of these studies, their content was determined and the role of the materials of the distance-type sounding in its creation. The works begin now on the base of the receiving experience on the creation of the electronic atlas, showed the changes of the natural environment as a result of the intensive economical developing at the creation of the oil and gas complex and the other branches of industry on the West Siberia territory – one of the most intensively developing regions of the Russian Federation.

Particular results of these works, illustrated with examples space images, maps and their legends (in the traditional and digital versions), are reflected in the report.

The scientific and practical achievements in ecological mapping of Russia do not solve all existing problems. There is a problem of the topographic map upgrading for all scale series and digitizing of these maps, it is impossible to do the

qualitative ecological mapping without that. The starting information acquisition systems are needed of perfection, first of all, satellite ones (it is necessary to perform launchings of space vehicles at a level 1989–1990). The solution is needed of problems of interchange by the topographic, geodesic and ecological information between the ministries and offices occupied by the ecological mapping. It is actual to create of the state system of the aerospace, cartographic and geoinformation support of ecological safety of Russia and to include of automated ecological mapping into the united state system of ecological monitoring. It is necessary to coordinate the ecological actions, to except of duality and overlapping, to introduce of the uniform requirements to composition and contents of ecological maps and to develop methods of creation of electronic ecological maps.