SPACE IMAGES IN "THE NATIONAL ATLAS OF RUSSIA"

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One of perspective methods to introduce astronautics achievements in cartography is space information use at creation cartographical products which can be developed as for territory of our country and its separate regions, and for countries, continents and the world as a whole.

Use of the space information at creation of cartographical products is carried out in several directions. The space information can be used for updating topographical and geographical bases; as a source of the special contents of thematic maps; as an independent source of the information on the nature and economic development of various territories or as a source essentially supplementing the information which is received by other methods; as a photo art illustration of the Earth various areas shape. Besides atlases-albums have gained ground which show opportunities and methods of the space information use at decision of various problems. The tendency of space images atlases creation on territory of the separate states, large regions, cities was outlined. For example, such products are created in China, Germany, the USA, etc.

In our country the extensive fund of various kind domestic space images is accumulated up for many areas of the globe and Russia territory; methods of the space information processing are developed; significant experience of the space information application is amassed at studying natural resources and social and economic objects.

Space images of a terrestrial surface now more often are located in large cartographical products, namely: complex world, national and regional atlases, and also some thematic (branch) atlases and series of maps. Inclusion of space images in atlases essentially improves quality of a cartographical product. Space images display many geographical aspects in some cases better than maps, and in other cases – essentially improve interpretation of a theme together with maps.

In our country some prominent cartographical products are developed in which space images are presented widely enough. They are: "Atlas of snow-ice resources of the World"; Resources and Environment World Atlas. Природа и ресурсы Земли"; Electronic atlas "Our Earth"; "National atlas of Russia" – volume I "General characteristic of territory"; volume 2 "Nature. Ecology", volume 3 "Population. Economy"; volume 4

"History. Culture"; "Geographical atlas of Russia". At creation of these products the researches on development and realizations of the space contents concept of the above-named atlases have been carried out.

By development of the National atlas of Russia concept, of the first volume "General characteristic of territory" concept, of thematic volumes of the National atlas of Russia concepts and programs the big attention was given to inclusion of space images in four volumes of the National atlas of Russia. In the National atlas of Russia space shootings materials of the Roskartographya, the Federal Hydrometeorology and Environmental Monitoring Service, the All-Russia Research Geological Institute of the Ministry of Natural Resources, the Open Society «Space-rocket corporation "Energy" and the Institute of Geography of the Russian Academy of Sciences are used.

The topicality of the space information use in the National atlas of Russia is caused also by requirements of provision high quality, reliability, contemporaneity and design, as separate volumes, and the National atlas of Russia as a whole.

Necessity of space shooting materials inclusion in the National atlas of Russia as a whole and in the first volume, in particular, is proved in the Concept of the National atlas of Russia and the Concept of the first volume of the National atlas of Russia "General characteristic of territory".

The basic purpose of space images inclusion in **the first volume of the National atlas of Russia** is providing a high scientific and technical level of the National atlas of Russia as a whole and the first volume contents, in particular, due to granting to readers of the atlas the original, distinct from cartographical, high-quality information on a terrain. Space images are an independent source of the information on territory of Russia, a source essentially supplementing the cartographical information, and also are an art illustration of various areas of our country photo portrait.

The basic requirements to the space information represented in the first volume were: high contrast and high quality of images, prevalence of color images; cloudiness no more than 10–20 % of a picture area; summer period of shooting.

Space images of the first volume of the National atlas of Russia are included in *section* "*Geographical regions and the seas washing territory of Russia*".

Space images are placed *as three blocks* at the end of regional subitems – *the European part of Russia, the Asian part of Russia, the Russian sector of the Arctic regions*. It has allowed emphasizing an independent role of space images in the first volume and besides it was effective from technological positions.

Schemes of space imagesan arrangement are presented on pages with subitems fly titles of the volume sections . The arrangement of space images within the limits of regions of

Russia (the European part of Russia, the Asian part of Russia, the Russian sector of the Arctic regions) is presented on three pages of the atlas.

"*Space*" *pages of the atlas include space images, summaries to them and address maps.* For display of some large regions of the country the small-scale space images received from domestic operative space systems *of optical-electronic monitoring for the natural - resources, oceanographic and hydro meteorological purpose* are included in the first volume (space vehicles of type "Ресурс–О1", "Океан–О1", "Океан–О3", "Метеор") with scanning devices МСУ–СК, МСУ–С, МСУ–2. Small-scale space images of the first volume of the National atlas of Russia illustrate following territories of our country: the Lower Volga region; the Barabinskaja lowland, the Kulundinskaja plain, the Priob plateau; South of the European part of Russia; Northeast of the European part of Russia; the Kamcinclusion of hatka peninsula.

In the prevailing majority in the first volume of the National atlas of Russia the space images received *as a result of optical-photographic shooting* from domestic automatic space vehicles of space subsystem "Ресурс–Ф" – "Ресурс–Ф1", "Ресурс–Ф2", "Ресурс–Ф3" are presented.

At choice of the space information for inclusion in the first volume of the National atlas of Russia the preference has been given to *spectrozonal images*. Spectrozonal space images received by photographing on two-layer color spectrozonal film in ranges of 570–680 and 680–810 nanometres, display territory of research in conditional colours. The color scale of the spectrozonal shootings photo prints, received at photo press with three filters, is close to natural colours. The contrast mosaic of these images color scale inherent in various types of landscape, natural and anthropogenous objects, elements of an infrastructure, infringements of the environment, allows to differentiate these objects with greater reliability, than on black-and-white space images. Borders of objects on these images are precise and sharp.

In some cases high-quality *black-and-white space images* with the precise contrast image were used. Black-and-white images are presented in the first volume of the National atlas of Russia mainly on islands of the Russian sector of Arctic regions and northern areas of Russia. At presence of polyzonal space images their computer processing for creation the synthesized images has been done.

The automatic space vehicle "Ресурс–Ф1" provided polyzonal and spectrozonal information reception from height of 240–355 km. On the vehicle six film-making systems have been mounted: a stellar camera; three cameras polyzonal complex *KATE-200* with a frame format 18×18 cm; two long-focal-length large-format cameras *КФА-1000* with the frame format 30×30 cm.

Three cameras polyzonal complex KATE-200 provided reception of a polyzonal video information with the spatial resolution 15–30m at width of a shooting strip 144–213 km.

In the first volume of the National atlas of Russia the space images received by space vehicle KATE–200 on following areas are presented: the Kola peninsula; the Yamal peninsula; the Baikal lake, Northern Pribaikalye; the Barguzin hollow; the Moма ridge; the Severnaya Zemlya; the Wrangel island.

Photographic system КФА-1000 had original scale of photos about 1:200000–1:270000. The ground resolution – 6,0 m. Width of the shooting strip – 144–213 km. The area displayed on one frame was about 6500 км². High resolution of this information enables the big enlargement, thus quality of images essentially does not vary.

In the first volume of the National atlas of Russia the greatest quantity of the images received by space camera КФА–1000 is presented. They occupy 32 pages in the volume of the atlas.

The automatic space vehicle "Ресурс–Ф2" has been equipped by the stellar camera and polyzonal cameras МК–4. The photo system of the МК–4 had four spectral channels and allowed to carry out synchronous polyzonal and spectrozonal photo shootings of the Earth surface with high geometrical and photometric characteristics. Frame size – 18×18 cm. Capabilities of "Resurs–F2" allowed to change repeatedly height of a working orbit from 180 up to 355 km with the purpose of carrying out non-uniformly scaled shootings with various resolution. Original scale of received images – from 1:550000 up to 1:1500000 in a strip of shooting from 100 up to 200 km. At scale of shooting about 1:800000 the ground resolution makes 10–12 m. In the first volume 17 space images received by МК–4 are presented.

The automatic space vehicle "Ресурс–Ф3" has been equipped by two cameras КФА-3000, allowing to receive images of format 30×30 cm with the spatial resolution of 3 m in scale 1:90000–1:140000 and the strip of shooting 55–84 km (width of the two frames strip). Two space images received by КФА-3000 are included in the first volume of the National atlas of Russia. They are the Bering Strait, the Dezhnev Cape; the Novosibirsk Islands, the Koteljny Island.

In most cases in the first volume of the National atlas of Russia space images *of larger scale* (in comparison with geographical maps of the given section) are presented. Such scale causes display in images of a part of the territory shown on geographical map of given region. At space provision of the first volume of the National atlas of Russia both contact, and the enlarged space images are used. For example, for illustration of large cities lay-out, detailed characteristics of territory and objects in large scale, the contact and enlarged space images received by device КФА-1000 are used. For illustration of physical-geographical conditions of large areas of territories the space images received by devices МК–4 and КАТЕ–200 (contact and enlarged) are used.

Pages with space images preparation for edition was done on the basis of computer technology, uniform for all the National atlas of Russia, and consisted of work on "*space page*" *components – space images, address maps and text materials (*summaries to space images, headings, page numbers, scale notes).

Space images. Made from originals of space images the double-positives or double-negatives were scanned on drum-type scanner TANGO of Linotype-Hell Co. with resolution not less than 300 dpi and color corrections with the purpose of bringing a colour rendition near to natural colours. Processing of images was done on Apple Macintosh computers in Linocolor 4.2 and Adobe PhotoShop 5.0 programs.

Address maps. An address map is a fragment of geographical maps from the first volume of the National atlas of Russia. The address map shows geographical "binding" of objects which are visible on the given space image. Fragments of maps are "cut out" from files with geographical maps records on the territory displayed on the space image and its nearest areas. On the address map borders of the territory displayed on the space image were "beat off". The address map is located on one page with the space image and the summary to it.

According to the developed computer technology of the first volume of the National atlas of Russia drawing up, address maps of pages with space images in order to prevent duplication of works were made on the basis of corresponding geographical maps of the first volume in scales 1:2500000, 1:1000000 or 1:500000. A scale of the address map was got out according to the space image scale.

Summaries to space images accompany all space images of the first volume of the National atlas of Russia and are located on the same page, as the space image. In summaries help technical data on the space image (a kind of space shooting, a camera, scale of the image) and the brief description of the territory displayed on the space image are given. Summaries to space images illustrate an ability of reception the helpful information from pictures for the geographical mapping purposes and solving those or other scientific and practical problems.

Summaries have been prepared for space images of the first volume of the National atlas of Russia by the experts-geographers well knowing a given region or owning sufficient information base on the given territory. Author's texts of summaries have been edited with the purpose of unification their structure and conformity to volume of the place allocated for them on the page. Final definition of the summary content and its editing was done after the first stage of computer making-up of pages at which exact borders of space images and volume of summaries have been certain.

Making-up of pages. After files of all making parts of the "space page" had been prepared (raster space images, vector address maps and text summaries) making-up of the atlas pages by installation of these files on publishing computers of Apple Macintosh

series in QuarkXPress 4.0 software package was done. Making-up was carried out in view of the general requirements to configuration and design of the atlas as whole and specific requirements to pages with space images. The general requirements set a format of pages, position of folios and headlines on them, types and size of fonts, sizes of back edge. To pages with space images the requirements of space images accommodation at page edges, combinations on one page of space images, address maps and text summaries, presence of a color background on borders under summaries, folios and headlines were specific. Thus there were certain difficulties:

1. Space images have a wide color scatter, differ on color scale from address maps, therefore to choose the uniform background which is meeting the requirements of design, for all pages it was very complex;
2. It is impossible to define at once the sizes of the space image, the address map, volume and content of the summary. These parameters were fulfilled during installation of page. Space images were located on a place, allocated to it on a page of the atlas on a breadboard model of assembling. Thus the scale of the space image and horizontal sweep of the image change. Into the space image are inserted the headline and the folio.

In this connection making-up was done in several stages. As a result of the first stages of page making-up exact borders of the space image, size of the address map and the summary were defined. According to black-and-white printer proof on the address map exact borders of the space image were “beat off”, volume and the content of finally edited summaries were defined. After that final making-up of page was done by results of which the color printer proof was done.

After viewing the printer proof of the made-up page and its approval by the Control Editorial Board of the Central Cartographic-Geodetic Center (TsKGF), the colour separation and output to a film of four colour separated positives (a polygraphic triad + black) were conducted. Colour separated positives were used for printing of colour proofs and circulation. Printer and colour proofs have got approval by the Editorial Council, the Editorial Board of the first volume and the Main Editorial Board of the National atlas of Russia.

The developed technology has allowed achieving high polygraphic quality of space images with preservation of natural colour rendition.

Space images of the first volume of the National atlas of Russia have given idea about physical-geographical features and modern shape of various areas of our country, their economic development, character of large cities lay-out and natural features of their vicinities. Space images essentially differ from cartographical images: they show at the moment of shooting the natural shape of a terrain constructed under objective laws of optical generalization while maps display the terrain in conventional signs on the basis of subjective generalization, frequently with use of occurring at different times and not visual (but not less valuable) information. Therefore sharing of cartographical and space

images of the terrain will allow the reader to make fuller idea about territory of Russia and its areas.

The experience received at work on space provision of the first volume of the National atlas of Russia, is used at creation of the subsequent volumes of the National atlas of Russia.

Space images of **"The National Atlas of Russia" volume 2 "Nature. Ecology"** have illustrated all spectrum of their possible usage for study and mappings of the country environment and resources. The structure of volume has allowed to use space images in volume sections: Introduction; Evolution of the environment; Geological structure and subsoil resources;Rrelief; Waters of a land; Snow. Ice. Frozen ground; Seas; Soil cover and land resources; Vegetation; Landscapes; Environment condition; Conservancy. Space images have significantly expanded interpretation of sections themes and have made volume decorating to be more attractive. Space images are accompanied by brief summaries to them. Overlapping of interpretation logic and space images descriptions with maps legends and maps has allowed opening an author's plan of the last more full.

In the *Introduction section* "Russia from Space" is presented with fragments of space images on separate areas of our country – Arctic regions. The Franz Josef Land; The Samarskja Luka. The Zhigulis; The Big Caucasian ridge; The Ob average watercourse; The Baikal. Outh of the Top Angara river.

Various subjects of the "*Geological structure and resources of bowels*" part also is illustrated by space images. For example, the theme "Volcanism" is illustrated by the space image "Volcanos the Koryak Hill and the Avachi Hill". The theme of "Deposit of ferrous metals" reveals by display of the magnificent modern space image of the Lebedinsky iron-ore deposit located near to city Gubkin (the Kursk magnetic anomaly). The space image of the Vyshnevolotsk lowland (the Tver area) with peat development in the Tereles peat deposit helps to reveal a theme "Resources of peat". In a theme "Geological nature sanctuaries" the space image "Lake Elgygytgyn (the Chukchi autonomous region)" is presented.
Sections "Relief" and "Snow. Ice. Frozen ground" please with riches of the space images reflecting the most interesting subjects of these sections. Space provision of these two sections is executed in creative cooperation of employees from PKO "Cartographia" of Roskartographya and the Institute of Geography of the Russian Academy of Sciences.

A plenty of space images is presented in section "*Relief*". The theme "Orography" reveals examples of space images: North West – The Siberian plain; The Baikal highland. Southern Pribaikalye; The Kolyma range. The Sejmchan–Buyundin hollow; The Amur rever valley and North West the Sihote-Alinj foothills. Theme "Geomorphology. Morphostructure" is illustrated by several space images: Blocky and magmatic island mountains. The Khibiny; Zone of a joint folding–thrust ridges Verkhojynje, accumulative the

Nizhnelensk lowland and dividing them stratal inclined plain; Graben intermountain hollow in the Transbaikalje. The theme "Modern relief forming processes" is illustrated by the modern magnificent space image of accumulation in the Volga delta and on coastal shoaling water. In a theme "Channel processes" the space image displaying "Free bends of the river Sorominskaja" (the Middle Priob) is presented.

The section "*Water of a land*" is illustrated by several space images: Delta of the river Lena; Lake Baikal. Island Olkhon.

In section "*Snow. Iice. Frozen ground*" the greatest quantity of space images, in comparison with other sections of volume is presented. Theme "Stocks of snow and ice" is illustrated by examples of space images: Glacial cover on the Franz Josef Land; Mountain glaciers of the Big Caucasus; Glaciers of the Russian sector of Arctic regions are illustrated by the space image: Glacier of the Academy of sciences on island Komsomolets and a Glacial dome on the Schmidt's Island. The theme "Glaciers of mountain regions" reveals photos and space images: The Altai. The Katunj Belki. Mountain Belukha (Republic Altai); Mountain Elbrus; Caucasus; Glacier Kolka, october, 2002; Mountain Kazbek, Glacier Kolka, october, 17th, 2002.

The section "*Sea*" is illustrated by space images of coasts of the seas washing territory of Russia: Coast of Novorossijsk and its vicinities; Coast of sea of Azov; Delta of the Volga; The Northern Earth.
In sections "*Soil cover and ground resources*", "*Vegetation*", "*Landscapes*", "*Condition of environment*", "*Wildlife management*" the presented space images have shown a possibility to estimate a modern condition of ground resources; distribution of landscapes and their morphological structure; character and a degree of anthropogenous disturbance of natural territorial complexes; to see territorial distribution of the adverse natural processes caused by economic activities of human. Also examples of aerial photographs with characteristic structures of a soil cover are resulted.

In **volume 3 " Population. Economy"** of the National atlas of Russia space images by means of which various types economic development of territory are shown, characteristic features of settlements lay-out, features of the economic objects territorial organization, objects of tourism, sports, etc. are presented.

In section "*General characteristic of territory*" the theme "Geographical data on Russia" is illustrated by space images: The city of Kaliningrad; The Altai. The Katunj ridge; The city of Saint–Petersburg.

In section "*Geographical conditions of setting and facilities*" the theme "Economic development of territories" is illustrated by space images: The Steppe Ciscaucasia. Southwest part of the Tersko-Kumsk lowland; Eastern European forest–steppe. The Kuvash River basin, the left inflow of the river Belaja The Zavolzhje high steppe. Interfluve of the rivers the Samara and the Chapaevka; Moscow suburbs; Western slopes of Northern

Urals Mountains. Timber industry use of territory. Throw; The Chukotka. Peninsula Daurkina with cape Dezhnyov; The Near–Caspian lowland. The Volga-Akchtuba floodlands. On the above-named presented space images types of economic development and various degree of land reclamation, depending from many various reasons – environment and resources of territory, territorial remoteness from the central areas and the main means of communication, from accommodation of the population on territory of the country and other reasons are well visible.

In section "*Population and social development*" of subitem "Population and settlement" a theme "Settlement of townspeople and rural population" is illustrated by the space image of the city of Moscow; a theme "Functional settlement" is illustrated by the space image of vicinities of city of Samara with agricultural type of settlement. In subsection "City settlement and urbanization" as an example of large city agglomeration the space image of city Greater Sochi – New Matsesta is presented. In subsection "Health of the population. Medical ecological division into districts" in the characteristic of medical ecological areas of the country space images of two areas are presented: The Kaluga–Ryazan area is illustrated by picture of the Kasimovsk district of the Ryazan area; at the characteristic of the Nizhnevolzhskaja area the picture of the Volga lower reach is presented.

In section "*Social sphere*" of subsection "Recreation. Tourism. Sports" a theme "Sochi – capital of 2014 Winter Olympic Games" reveals by illustration of the perspective space image of city Greater Sochi and the space image of the most high-mountainous resort area – the Krasnaja Poliana which is located in the Adler district of city Greater Sochi in 40км from coast of the Black sea at height 600м above sea level.

In section "*Infrastructural sphere*" of subitem "Transport and transport networks" in a theme "Internal waterways" space pictures of cities Saint–Petersburg, Novorossisk, Vladivostok are presented.

In section "*Regions and regional development*" space images are presented of some centers of Federal districts – The city of Ekaterinburg (the Ural Federal district); The city of Novosibirsk (the Siberian Federal district); The city of Khabarovsk (the center of Far East Federal district).

In **volume 4 "History. Culture"** in subitem "Culture" the theme "Cultural and natural heritage of Russia" reveals by maps of separate subjects of the Russian Federation with allocation on them of monuments of the World, federal and regional levels of protection with display of different categories, namely, archaeology, history, architecture, monumental art. The given theme also is illustrated by several space images which reflect objects of a cultural and natural heritage of some areas of the country. For example, the magnificent space picture the "Samarskaja Luka" displays all landscapes variety of this unique area of our country. The space picture shows two especially protected natural territories of federal value: "The state natural reserve Zhiguli" which is one of the oldest

natural reserves of Russia, created in 1927, and “The National park “Samarskaja Luka” created in 1984. The space picture of Southern Transbaikalje shows territory of “The Tunkinskij national park” and the “Baikal reserve”, organized in 1969 on southern shore of lake Baikal in area of ridge Khamar-Daban. In 1986 to the Baikal reserve the UNESCO biosphere reserve status has been appropriated. In the subitem space images of cities Bratsk and Khabarovsk are presented.

The prospect of the space information use for mapping and studying of cultural and natural objects is great.

Vivid example the result of cooperation between two organizations namely “Engineering-technological center SkanEks” and Noncommercial partnership “The transparent world” – the edition in 2005 of magnificent materials with fine space pictures can be. It is the project “World heritage from Space” which first result became the edition of the atlas “World heritage in Russia”, including 10 objects. In 2007 they published the guidebook “On Moscow natural parks and reserves”.

Inclusion of high informative space images in “The National Atlas of Russia” has illustrated possibilities of its use at creation of the new information documents reflecting natural and social and economic objects, an ecological condition of the environment, and degree of anthropogenous influence on natural complexes.