RUSSIAN SCIENTIFIC RESEARCHES ON MAP AND SPACE GENERALIZATION

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Abstract
To scientific bases of generalization researches of geographers and cartographers are devoted to N.N.Baranskiy, V.I.Suhov, A.M.Komkov, N.I.Shilov, A.S.Nikolaev, A.F.Aslanikashvili, K.A.Salishchev, A.S.Vasmut, I.P.Zarutskaya, A.M.Berljant and other Russian scientists. According to A.M.Komkov, N.I.Shilov, A.S.Nikolaev's definition, map (cartographical) generalization represents process of revealing and display on maps of essential, typical properties and prominent features of mapped subjects and the phenomena. In Russia collectives of experts were engaged and engaged in development of questions of the theory and practice of map and space generalization. The volume and level of study by groups of researchers of generalization questions, satisfaction to attributes of concept " scientific school » allows to allocate the Russian scientific schools generated for many decades on generalization with the original approaches and distinctive features.

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1. INTRODUCTION

One of the important questions of drawing up of maps in traditional and digital form is map generalization, influencing on completeness of the maintenance, practical value and scientific advantages of maps of different purpose and scales. The experience, which has been saved up for many decades of research-and-production works, has formed a basis for creation of various cartographical products. However, the variety of approaches does not allow speak about the full, exhaustive decision of this problem. Paramount value mathematical development the proved way (the mathematical device) the map generalization till now has, allowing objectively to carry out and supervise this process on the basis of modern computer technologies and materials of remote sensing of the Earth.

Generalization now any more is not only a specific cartographical problem. Approaches to its decision are offered within the framework of geoinformatics, data processing and remote sensing. At the same time, the decision of this problem within the framework of geoinformatics essentially keeps away from "cartographical" understanding of revealing typical and especial in selection and generalizations. Modern geoinformation technologies give this problem not much more attention, preferring to replace its essence, for example, databases of different scale levels, thus, excepting this process as such of a complex works of map creation.

2. RUSSIAN SCIENTIFIC SCHOOLS ON GENERALIZATION

For a long-term history of development of cartography in Russia scientific schools on generalization with the original approaches and distinctive features were generated. It is possible to attribute the following such schools.

- Cartographic faculty, Moscow State University of Geodesy and Cartography (MIIGAiK),
- Chair of Cartography, Geodetic faculty, V. V. Kuibyshev Military - Engineering Academy (VIA),
- Laboratory of geographical maps, Central Scientific Research Institute of Geodesy, Aerial photography and Cartography (TSNIIGAiK),
- Chair of Cartography and Geoinformatics, Geographic faculty, M. V. Lomonosov Moscow State University (MGU).

The report of Russian cartographical schools on map and space generalization we present in *Table.*

Table. **Researches of Russian cartographical schools on generalization**

Name of cartographical school	Elements of map maintenance	Scales	Publications on the basic questions of researches (according to chronology of the edition)
Cartographic faculty, Moscow State University of Geodesy and Cartography (MIIGAiK)	Settlements Hydrographic system Road system Borders	1:1 000 000 1:2 500 000 1:4 000 000 1:5 000 000 1:8 000 000	Bustrov A.G. Representation of settlements on general maps of the USSR. PhD. M.: MIIGAiK, 1939. p.195. Preobrazhenskiy A.I. Generalization of railway network of the USSR at drawing up small-scale general maps // Proceedings of MIIGAiK. 1957. 24. P. 95 - 104. Sukhov V.I. Creation and editing general maps. M.: Geodezizdat, 1957. p. 280. Shiryaev E.E. Multilevel principle of generalization and questions of automatic maps reading // Geographical science. M.: Science, 1972. P. 235 - 241. Vasmut A.S., Vergasov V. A. About some mathematical aspects of process generalization of the image of district on topographical maps // News of higher educational institutions. Series geodesy and air photography. 1984. № 6. P. 85 - 90. Vasmut A.S., Bugaevskiy L.M., Portnov A.M. Automation and mathematical methods in map creation. M.: Nedra, 1991. p. 390. Ivanov A.G., Krylov S.A., Tatarnikov A.N., etc. Automation of map generalization // Geodesy and cartography. 2000. №1. P. 33-36.
Chair of Cartography, Geodetic faculty, V.V.Kuibyshev Military - Engineering Academy (VIA)	Settlements Hydrographic system Road system Relief Soil - vegetative cover	1:25 000 – 1:200 000 1:25 000 – 1:1 000 000	Komkov A.M., Kostrits I.B., Sukhov V.I. Settlements, their selection, generalization and the image on topographical maps of scales 1:25 000 - 1:200 000: Practical manual on drawing up of topographical maps. M.: RIO VTS, 1943. 1. p. 92. Komkov A.M., Kostrits I.B. Hydrographic system and its image on topographical maps: Practical manual on drawing up of topographical maps. M.: RIO VTS, 1945. 2. p.112. Komkov A.M., Nikolaev S. A., Shilov N.I. Creation and editing of maps. M.: Publishing house VIA, 1958. p.245. Nikolaev S.A. Road system and its image on topographical maps: Practical manual on drawing up of topographical maps. M.: RIO VTS, 1947. 4. p. 204. Bocharov M.K., Nikolaev S.A. Mathematical-statistical methods in cartography. M.: Geodezizdat, 1957. p.158. Bocharov M.K. Capacity of settlements on map // Collected articles on cartography. GUGK. M.: Geodezizdat, 1956. 9. P. 35 - 43. Komkov A.M. To the question of essence and methods in cartography // Problems of geography. M.: Geographgiz, 1959. 27. P. 237 - 256.

Laboratory of geographical maps, Central Scientific Research Institute of Geodesy, Aerial photography and Cartography (TSNIIGAiK)	Settlements Hydrographic system Sea coast Road system Relief Soil - vegetative cover Borders	1:1 000 000 – 1:4 000 000	Sykhov V.I. Norms of settlements selection on small-scale geographical maps // Proceedings TSNIIGAiK. M.: Geodezizdat, 1951. Release 76. P. 73 - 88. Khersonskiy S.A. Generalization of a soil and vegetative cover elements on geographical maps // Proceedings TSNIIGAiK. M.: Geodezizdat, 1951. Release 76. p.134. Borodin A. V. To a question on selection of settlements on geographical maps // Collection of scientific, technical and industrial articles. M.: Geodezizdat, 1948. Release 18. p. 124. Davydov G.P. Image of a hydrographic network on geographical maps // Proceedings TSNIIGAiK. M.: Geodezizdat, 1953. Release 92. With. 45 - 56. Leontjev N. F. The image of sea coast on geographical maps // Proceedings TSNIIGAiK. M.: Geodezizdat, 1953. Release 92. P. 57 - 63. Bases of generalization on geographical of small scale maps. Under. J.V.Filippov // Proceedings TSNIIGAiK. M.: Geodezizdat, 1955. Release 104. p. 336. Davydkina T.V., Boginskiy V.M. Research on program selection of a river network on PC // № 31. Cartographical series. M.: TSNIIGAiK, 1974. P. 55-62.
Chair of Cartography and Geoinformatics, Geographic faculty, M. V. Lomonosov Moscow State University (MGU)	*Map generalization*		
	Hydrographic system (coastal line of islands and lakes)	Geographical maps – 1:2 500 000 – 1:4 000 000 Thematic maps 1:10 000 000 – 1:30 000 000	Baranskiy N. N. Generalization in cartography and in the geographical text description // Scientists of note MGU. M.: MGU, 1946. Release 119. Book. 2. P. 180 - 205. Salishchev K.A. Generalization in its history and modern development // Results of science and techniques. Series Cartography. 5. M.: VINITI, 1972. P. 6 - 23. Berljant A. M. Some pragmatic aspects of map generalization // The bulletin om MGU. A series 5. Geography. 1978. № 3. P. 45 - 53. Zarutskaja I.P., Svatkova T.G. Creation and drawing up of maps. Geographic maps. M.: Moscow State University, 1982. p. 208. Sventek Yu.V. Map generalization and cognitive levels of mapping // Scientific and technical progress and problems of the theory of cartography. M.: 1987a, P. 35-42. Berljant A. M, Musin O.R., Sobtchuk T. V. Map generalization and fractals theory. M.: MGU, 1998. p. 136.
	Space generalization *		
	Vegetation (wood)	Images MSU-E MSU-SK (Resurs-O, Russia) AVHRR (NOAA, US)	Kravtsova V.I., Vakhnina O.V. Generalization of the image on space scanner images of the different solution (experimental researches by the example of woods of Moscow suburbs) // Geodesy and cartography. 1999. № 8. P. 41-49. Knizhnikov Y. F., Kravtsova V. I. New aspects of traditional map problem of generalization // Collection. Interaction of cartography and geoinformatics. M.: Scientific world, 2000. P. 85 – 95. Kravtsova V. I. Generalization of aerospace image: continual and discrete images. M.: Moscow State University, 2000. p. 253.

*) Laws of the space generalization are studied by comparison of space images of different sanction.

2.1. Cartographic faculty, Moscow State University of Geodesy and Cartography (MIIGAiK)

Researches on map generalization spent A.G.Bystrov, A.I.Preobrazhenskiy, V.I.Sukhov, E.E.Shiryaev, A.S.Vasmut, A.G.Ivanov's. The historical aspect of development of researches methods of generalization is interesting. In particular, attempts to measure loading of settlements on a map have been undertaken by A.G.Bystrov (1939) in his dissertation. Display of settlements on general maps of the USSR has been considered. Change of loading depending on change of scales of maps can take place only on maps of large scales. According to the made conclusions, all maps more finely scale 1:200 000 can have, depending on scale, one maximum load settlements equal to 4-th settlements on 1 sm^2 of the map area. As a whole the task of selection of settlements on general maps is reduced to show of the settlements most typical for mapped territory from the point of view of accommodation the population and its activity.

Researches of V.I.Sukhov are devoted to definition of graphic loading of a map by settlements; it executes works on questions of classification and selection of roads. He has suggested and proved calculation of norms of selection of settlements on the basis of comparison of objects density on district with density of their designations on a map. According to V.I.Sukhov's (1947) researches, limiting graphic loading of a map the image of settlements together with signatures of their names makes 15 $мм^2$ on 1 sm^2, and its optimum value is equal 12 $мм^2$ on 1 sm^2. This method has been used by development of Manual on a map of scale 1:1 000 000 in 1951.

E.E.Shiryaev has applied the theory of the information to the description of process of generalization, has allocated two forms of generalization: scale and target generalization. A.S. Vasmut's works are devoted to automation of map generalization (Vasmut, Vergasov, 1984). Tasks of transformation of the maintenance of small-scale bases are considered by A. G. Ivanov (Ivanov, Krylov, Tatarnikov, etc., 2000). His empirical-mathematical method of selection of settlements, roads and hydrographic system is based on the analysis of the maintenance traditional general maps, revealing of distributions laws of objects density and their approximation by the mathematical device.

2.2. Chair of Cartography, Geodetic faculty, V.V.Kuibyshev Military - Engineering Academy (VIA)

It is necessary to name M.K.Bocharov, S.A.Nikolaev, A.M.Komkov, N.I.Shilov's works (Bocharov, Nikolaev, 1957; Komkov, Kostrits, Sukhov, 1943; Komkov, Kostrits, 1945; Komkov, Nikolaev, Shilov, 1958; Nikolaev, 1947)

The scientific research institute of Military - Topographical service of Red Army have been prepared also by Military - Topographical management of the Joint Staff releases of works (« the Practical manual on drawing up of topographical maps ») on settlements, hydrographic and road system as to basic elements of the maintenance of the topographical map, having military value (1943, 1945, 1947) are issued.

The first release of 1943 has been devoted to the image of settlements on topographical maps of large scales 1:25 000 - 1:200 000. All further releases (hydrographic and road systems, relief, soil - vegetative cover) were developed under the expanded program in which authors have considered features of the image of the listed elements of the maintenance on maps of scales 1:500 000 and 1:1 000 000.

2.3. Laboratory of geographical maps, Central Scientific Research Institute of Geodesy, Aerial photography and Cartography (TSNIIGAiK)

In Laboratory of geographical maps, Central Scientific Research Institute of Geodesy, Aerial photography and Cartography (TSNIIGAiK) methods of generalization of basic elements of the maintenance of topographical maps are developed. It is necessary to name works A.V.Borodin (settlements), G.P.Davydov (hydrographic network), N.F.Leontjev (sea coast), E.I. Efimenko (relief), etc. (47, 48, 92 and 104 releases of Proceedings TSNIIGAiK) on small-scale general maps the jobs executed under a manual by J.V. Filippov are devoted to map generalization.

Basis works on generalization in TSNIIGAiK had the following principles: first, necessity of development of classification with the characteristic of attributes and properties of object; second, division into districts (differentiation) of mapped territory and creation of samples with the purpose of maintenance of the uniform approach to generalization of a map; thirdly, studying of graphic opportunities of reproduction of the cartographical image.

2.4. Chair of Cartography and Geoinformatics, Geographic faculty, M. V. Lomonosov Moscow State University (MGU)

Researches on generalization on Geographical-cartographical school - Chair of cartography and geoinformatics, Geographic faculty, MGU are conducted in two directions: map generalization and generalization of space images (space, optical generalization).

Within the framework of *the first direction* N.N.Baranskiy, K.A.Salishchev, I.P.Zarutskaya, A.M.Berljant, S.N.Serbenjuk, O.R.Musin, T.V.Sobchuk, J.V.Sventek's works are known. N.N.Baranskiy's article « Generalization in cartography and in the geographical text description » began one of the first works on theoretical positions of generalization in which it was spoken that generalization increases capacity of maps (Baranskiy, 1946).

K.A.Salishchev (1972) allocates two detached stages of generalization. On the first initial designing a map when elements of the maintenance are determined, classifications for them is spent, norms and qualifications are established. Special value has this stage at automation of map generalization. At the second stage the map original is made by selection and generalization of objects. K.A.Salishchev has stated faithful to N.N.Baranskiy's opinion that qualitatively executed generalization is capable to reduce losses of the information.

I.P.Zarutskaya determines geographical principles of performance of map generalization, which are based on studying of an essence of mapped objects and the phenomena, laws of their interrelation, studying of natural figure of a terrestrial surface. Influence of genesis and natural character of represented objects and the phenomena is established on quality of cartographical generalization (Zarutskaja, Svatkova, 1982).

Researches on map generalization of linear elements of hydrography (a coastal line of islands and lakes) are executed on the basis of application of the theory of fractals (Berljant, 1978; Berljant, Musin, Sobchuk, 1998).

On *the second direction* the Laboratory of Space methods, Chair of cartography and geoinformatics works. Experimental researches are carried out under the management of V.I.Kravtsova and J.F.Knizhnikov. Definitions of space generalization have been given to B.V.Vinogradov (1976), G.B.Gonin (1980), V.I.Kravtsova (2000) and other authors. Generalization of space images represents change spatial and brightness characteristics of the image (geometrical and tone or color generalization of figure of the image), caused technical (scale and solution, method and spectral range of shooting) and natural factors (influence of an atmosphere, illumination, features of territory). According to the statement of work (Kravtsova, 2000) generalization of space images makes them by a valuable source for a rating of correctness of map generalization on the small-scale maps made on maps of larger scales.

Some laws of generalization of space images are shown in (Kravtsova, 2000; Knizhnikov, Kravtsova, 2000). The size of reproduced objects depends on their form and from contrast with a surrounding background. Linear, dim, mosaic borders and contours are differently generalized. As a whole the mechanism of space image generalization is represented as complex, laws of this type of generalization while completely are not investigated and not described, on application of space images for the control and rating of map generalization while it is not a lot of works.

2.5. Conclusions on scientific cartographical schools

The executed analysis of a modern level of approaches, methods and technologies of map generalization in traditional cartography and in the modern automated systems has allowed to formulate the following conclusions:

- Researches on map generalization in Russia are conducted, as a rule, by scientific research institutes, the state educational and industrial organizations. The problem of development of methods of generalization has priority value in a cycle works for map creation of the state organizations.
- Search of informative quantitative laws of map generalization remains an actual problem in cartography since 30th years of XX century. Interest of experts to study of questions of objects communications, their topological relations is marked.
- The most widespread attributes (factors) used in existing methods of generalization: loading, value of object on sets of quantitative and qualitative attributes, tortuosity, density of accommodation of objects on districts, scale of map.
- By development of methods the broad audience of mathematical theories and approaches of programming is used: object-oriented programming, the multifactor approach, theory of graphs, theory of datasets, theory of games, mathematical morphology, approaches of indistinct logic, neural networks, wavelet-transformations, theory of fractals.
- Three interconnected problems of automation map generalization are revealed and proved:
    - Development of the full formalized concept of generalization;
    - Creation of algorithms and programs in which operators of generalization are applied, development of generalization toolkit in GIS;
    - Development the system of rules on the basis of essences knowledge of generalization process (development of expert systems in generalization).
- Dynamics of development of researches from search universal dependences for generalization of objects of one type up to the complex methods which are taking into account set of elements of the map maintenance is traced.

- The share of the automated and automatic operations (procedures) in modern technologies of generalization increases. Final estimated quality assurance of the executed generalization, as a rule, is spent by the expert – cartographer.
- Modern technical and software allows reducing difficulties of manual process of generalization. There are preconditions to the decision of a problem of generalization by means GIS in the way as embeddings of additional modules, and researches of applicability of ready commercial products.
- Perspective directions of development and perfection of methods and technologies of the automated map generalization become space images application.
- The most widespread industrial decision of map generalization is databases of different scale levels and application of an interactive operating mode.

With the purpose of the decision of tasks in view it is necessary to investigate two directions. First, this establishment of an opportunity of division into districts (differentiation) of territory to various attributes (first of all, quantitative). Second, it is development of methods of generalization on various elements of map maintenance (Vasmut, Bugaevskiy, Portnov, 1991).

3. THE TECHNIQE OF MAP GENERALIZATION ON MEDIUM SCALE TOPOGRAPHIC MAPS

Medium scale topographic maps are used for general studying of large areas of Russia, general planning of actions of federal and regional value on natural resources development and economic construction, as flight maps. In a scale line (group) of topographical maps they provide continuity of topographical and small-scale mapping. The urgency of drawing up of medium scale topographic maps in Russia is caused by the significant sizes of territory, needs of subjects of Russia for the decision of problems of a regional level.

Available digital topographical maps of scale 1:200 000 and 1:1 000 000 on all territory of Russia (State GIS Center, Moscow, Russia) are digital variants of traditional maps of corresponding scales and do not include a map of scale 1:500 000. Value of development of a technique of the automated cartographical generalization of medium scale topographic maps is determined by requirements of manufacture, first of all state Aerogeodetic Enterprises of Roskartografiya.

Features of map generalization of medium scale topographic maps determine requirements for search a special quantitative and qualitative attributes, development of an adequate mathematical method on their basis.

3.1. Purpose of research

Purpose of research at the Chair of Cartography, Cartographic faculty, MIIGAiK is development the technique of map generalization of settlements, hydrographic and road system as three interconnected elements of the maintenance at the automated creation of medium scale topographic maps by the example of maps of scales 1:200 000 (M1) and 1:500 000 (M2).

The method is based on comparison of the maintenance of two traditional or digital maps of consecutive scales and revealing of the most informative attributes used for selection and generalization of objects, on the system (complex) approach to quantitative and qualitative parameters of displayed objects of district. The method is developed in view of experience and achievements Russian and foreign cartographers (cartographical schools), submitted in available topographical maps and offers development of existing methods and generalizations approaches, promotion regarding a mathematical substantiation of operations of selection and generalization.

The technique is based on the account of experience traditional map creation, submitted in the formalized kind. The suggested decision allows to approach from uniform positions to selection and generalization on a map area and linear objects to reveal and show interrelations of map generalization of three elements of the maintenance. An essence and positions of a technique for three elements of the maintenance on medium scale topographic maps are resulted in works (Bugaevskiy, Podolskaya, 2004, 2005).

3.2. Tasks of research

Realization of research purpose has demanded the decision of the following tasks:

- Studying, analysis of existing ways, methods and approaches to generalization in the traditional and automated form. Allocation of map generalization's features of maintenance elements on medium scale topographic maps;

- Development the model of map platforms (« cellular structure ») for generalization;
- Research of application methods of territory differentiation at generalization;
- Development of conceptual positions of generalization technique for settlements, hydrographic and road system on the basis of the chosen model;
- Development of software for map generalization (program modules of generalization);
- Experimental realization of the suggested technique and creation of samples library of maps on various types of Russian area;
- Application of space images for obyektivization map generalization as modern actual method of drawing up maps and rating of quality of the executed generalization.

The analytical method of map generalization is represented to the most expedient in view of universality for set of the interconnected elements of different character of localization what settlements, hydrographic and road system are. Research of applicability of an analytical method of generalization for other elements of the maintenance geographical maps is perspective. In work the author's researches on obyektivization of map generalization, executed at the Department of data processing and archiving technologies of Earth detailed supervision, Scientific Center of Operational Earth Monitoring (NTS OMZ, Russian Federal Space Agency) in 2004-2005 is used.

4. SUBSTANTIVE PROVISIONS OF TECHNIQUE: QUALITATIVE AND QUANTITATIVE GENERALIZATION

The suggested technique of map generalization on medium scale topographic maps is based on studying and comparison of the maintenance of maps of two adjacent (consecutive) scales, formation of quantitative and qualitative attributes of generalization. Analyzed materials are sheets of topographical maps of scale 1:200 000 and 1:500 000. System principles of map creation assume the obligatory joint account of the image of one object from other objects.

Proceeding from definition of map generalization (Komkov, Nikolaev, Shilov, 1958) by development of a method of generalization we started with necessity of use of the complex, system approach to display of the mapped validity.

In the conceptual plan in suggested technique two parts are selected: research and practical. Their basic distinction will be, that in a research part sheets of a map are studied, there is an accumulation of the information, recommendations on selection and generalization are developed on the basis of two maps 1:200 000 and 1:500 000.

The mainframe of the technique is quantitative generalization where the parameters of loading describing spatial distribution and the sizes of objects are established: for settlements - factors of frequency and density, for hydrographic and road systems - factors of frequency, length and density. The quantitative side of generalization is based on definition of laws changes of the map maintenance with change of scale and consists in an establishment of analytical dependences between the maintenance of initial and created maps. For each element of the map maintenance the characteristic attributes (properties) are established.

In suggested technique performance of quantitative and qualitative generalization of elements of the medium scale topographic maps maintenance, which can be subdivided into three stages is considered:

- Qualitative generalization (primary) to the basic qualitative attributes - the automated stage.
- Quantitative generalization, which is carried out in an automatic mode (program modules).
- Qualitative generalization (secondary), which is carried out in an interactive mode and influences result of quantitative generalization.

5. PROGRAM MODULES OF QUANTITATIVE GENERALIZATION

During development of a technique there was a necessity of a choice and use of the programming language. Means Visual Basic is applied for programs creation of quantitative and qualitative parts of technique. Measurements on maps within the limits of platforms, calculation of factors, differentiation of territory and an establishment of analytical dependences are realized in work of program modules. Program codes on Visual Basic can be built - in and organized in the environment of majority professional GIS that determines the basic advantage of use this software in the developed technique. Functionalities of Visual Basic v 6.0. adequately correspond to task in view of reception of graphic representations. Means of language provide original technology of map generalization on medium scale topographic maps about conformity with the developed mathematical device of an suggested method. The following program codes are created:

- Construction of diagrams of settlements accommodation on sheets of analyzed maps (scale M1 and M2);
- Calculation of the area of the settlements image;

- Application taxonomic and discriminant methods for territory differentiation on area size of the settlements image.

6. APPLICATION OF SCANNER SPACE IMAGES FOR OBYEKTIVIZATION OF MAP GENERALIZATION ON MEDIUM SCALE TOPOGRAPHIC MAPS USING SOFTWARE ERDAS IMAGINE 8.5

In practice of works on drawing up of topographical maps of all scales the space images of different type and the solution are use. Information opportunities of space images are caused by their spatial sanction or resolution. The sanction of a space image is known, that the more, the more than works on map generalization necessary to execute at drawing up or updating of maps.

In classification of approaches to the decision of map generalization resulted in work (Bugaevskiy, Tsvetkov, 2000) by authors the separate direction - obyektivization of map generalization, based on use of space images of small scales is allocated. As a result of essential reduction of image scales, remove of high frequencies of radiation on images there is an effect of optical or space generalization therefore it is more evident and large forms of elements of district are objectively opened and selection of fine objects is practically carried out.

The basic purpose of space images application is represented as a rating of quality of the executed generalization, entering of objectivity into this creative process. Space images are used alongside with a method of expert ratings, pictures are distinguished with a way of image reception, caused by influence of means and conditions of territory shooting.

6.1. Technology of space images application

Technology of space images application for map generalization (Podolskaya, 2005) consists of three stages:

- Choice of a space image,
- Preliminary processing an image and a map,
- Carrying out of visual comparison and measurements on a map and an image.

The choice of a space image is influenced with seasonal conditions at the moment of carrying out of shooting. The picture should be received during the snow less period, for comparison of the image of hydrographic system in low water level is necessary.

Sequence of processing of image we will consider for MSU-E, Meteor 3M №1. In fund NTS OMZ the figures acting from the satellite, are exposed to processing in the specialized package of applied programs RESPON, development of NTS OMZ, which provides extraction of multispectral images MSU-E from the initial ("crude") digital dataflow.

For different searches of users some levels of processing are accepted. At a zero level remove of pulse handicaps, correction and restoration breakdown and the missed lines, formation of the text summary is carried out. Then updating of the image at a level "1" which includes processing a level "0" and additional operations is spent: photometric correction by a statistical method, geographical binding on the orbital and telemetry data, formation of the summary in the raster form (http://www.ntsomz.ru).

Given image MSU-E is prepared in conformity with a level of processing "2" that includes processing a level "1" with the following additions: elimination of geometrical distortions with bilinear brightness interpolation; transformation in a cartographical projection; geometrical overlapping of spectral channels MSU-E with the increased accuracy. In result file of the multispectral territory image in a cartographical projection (Gauss-Kruger, UTM) with the set pixel size in internal format RESPON or in well-known formats LAN, TIFF, JPEG turns out. For suggested work image were it is received in format LAN, which is supported by program Erdas Imagine 8.5. For the further processing transformation of the image to format Erdas Imagine .IMG is executed. To improvement of the image of a picture apply functions of contrast (Contract) and remove (Filtering).

Simultaneously with processing a space image scanning drawing up prints of a map on the special scanner is carried out. Color large-format drum-type scanner PROSKAN 60030 "KSI" with the optical solution 600 dpi, limiting error of scanning no more than 0.17 mm, a format of target information TIFF 6.0 was used. Sheets of a map are scanned with the solution 300 dpi and imported in Erdas Imagine from format TIFF to universal format IMG. Thus, receive raster space image and a map. For a rating of map generalization and a space image comparison of theirs in one projection is necessary by binding and transformation. On main panel Erdas Imagine gets out Data Preparation / Image Geometric Correction. Then in a viewer (window for viewing images) the transformed map, and atop of it - the transformed image opens. The order of these layers is established in View / Arrange Layers.

6.2. Carrying out of visual comparison and measurements on a map and an image

In Erdas Imagine 8.5. there is an opportunity of simultaneous viewing of the images imposed against each other in one viewer. For this purpose Utility inside which there are functions Blend (change of a transparency) and Swipe is used. Change of transparency Blend of the top layer (a space image or a map) is carried out by means of a scale with runner. In mode Auto Mode two images gradually will pass each other.

Management Swipe is carried out also with the help of a scale with runner. It is possible to close the top image all bottom or, on the contrary, to leave images overlapped only in part. Change of a direction of movement Swipe with Vertical on Horizontal is possible. In an operating time with the listed tools the scale of the space image and a map can be changed. So comparison of a map and a space image is practically carried out.

Thereby, space (optical) generalization represents a separate independent scientific direction, last years works on integration of this researches with map generalization have appeared. Necessity of such integration now is recognized as researchers, there are scientific publications on this question (Knizhnikov, Kravtsova, 2000).

Opportunities of use space scanner images can be expanded in the technological plan by research of combinations of functions of image processing in different software and comparisons of results. Besides it, for direction obyektivization of map generalization on images use of foreign materials of different type and solutions is perspective.

7. CONCLUSIONS

In this paper we discussed results of works on generalization in Russia. Development of methods and technologies on generalization in Russia closely adjoins to researches of scientists all over the world. The Soviet and Russian scientists use operating experience of their foreign colleagues. Foreign researches on map generalization are characterized by the big variety of directions and decisions. In XX century we know works E.Srnka (1970) and F.Topfer (1974), L.Ratajskiy, A.Getts and others. Directions of development of methods and technologies of map and space (optical) generalization are connected to integration and interaction of scientific researches on this question on a global scale. There is an experience of different forms of joint research work in the state and not state organizations, for example:

- Research group on automatic generalization at the European organization on studying and research photogrammetry (OEEPE),
- European scientific fund, the program of researches GISDATA,
- American state center under the geographical information analysis (NCGIA),
- International cartographical association (ICA) and ICA-conferences,
- The ICA Commission on Map Generalization and Multiple Representations « Computer generalization of Spatial Data », etc.

Results of development of map generalization technique on medium scale topographic maps are published in works (Bugaevskiy, Podolskaya, 2004, 2005; Podolskaya, 2005). Positions of technique are discussed at scientific seminars and meetings of Cartographic faculty, annual scientific - practical conferences of students, post-graduate students and young scientists MIIGAiK (2003, 2004, 2005). Reports at conferences are submitted:

- At Faculty of physical geography and cartography of Kharkov V.N.Karazin National University (Kharkov, March, 2003),
- At International scientific and technical conference devoted to 225-anniversary MIIGAiK (Moscow, May, 2004),
- On scientific congress " GEO-Sibir-2005 " (Novosibirsk, April, 2005),
- On V International conference « Young scientists - the industries, to science, technologies and vocational training: problems and new decisions » (Moscow, All-Russia Exhibition Center - VVTS, June-July, 2005).

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