SSUGT
SIBERIAN STATE
UNIVERSITY OF GEOSYSTEMS
AND TECHNOLOGIES

Vestnik SSUGT
Scientific journal
Published since 1996
Issued 4 times a year

Volume 22(3), 2017

Before 2015 journal
was published under the name
«Vestnik SSGA»

Starting from 2017 numbering of the volume refers to the number of years the journal has been circulated. The number of the issue refers to how many times the journal was published during the year

CONTENTS

GEODESY AND MINE SURVEY

CARTOGRAPHY AND GEOINFORMATICS

Registration certificate
PI № FS 77-62654 of 10.08.2015

The journal is included in the List of refereed scientific journals, recommended by HAC for publishing the scientific results of dissertations in candidacy for a degree of Candidate or Doctor of Science degree

Journal included in Russian Science Citation Index (RSCI)

Subscription indexes in catalogues:
«Russian press» – 43809
Electronic catalogue «Russian periodicals» (www.ideg.ru) – 43809э

Layout editor of journal
A. V. Koneva

Reduction address:
630108, Novosibirsk,
10 Plakhotnogo St., r. 436
E-mail: vestnik@ssga.ru
Tel. (383)361-06-55
http://vestnik.ssga.ru

English translation
D. V. Romanov

Editors:
E. K. Dehanova
E. N. Uchenova

Desktop publishing
K. V. Ionko

Signed to print 18.09.2017.
Format 70 × 100 1/16.
Conv. pr. sheets 20,08.
Circulation 1 000 copies.
Order 141.

Printing and publication department SSUGT
630108, Novosibirsk,
10 Plakhotnogo St.

Printed in map printing laboratory SSUGT
630108, Novosibirsk,
8 Plakhotnogo St.

LAND MANAGEMENT, CADASTRE AND LAND MONITORING

OPTICS, OPTICAL AND ELECTRONIC DEVICES AND COMPLEXES

ECOLOGY AND ENVIRONMENTAL MANAGEMENT

GEODESY AND MINE SURVEY

MAPPING SUPPORT OF ENGINEERING AND GEODESIC WORKS IN A MOUNTAINOUS AREA SUBJECT TO THE SECTION PLANE

Dinara A. Abzhaparova
Osh State University, 714000, Kyrgyzstan, Osh, 31 Lenin St., Associate Professor, phone: (996-03-222)5-45-65, e-mail: 0777859505@mail.ru

Boris T. Mazurov
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Professor, Department Physical Geodesy and Remote Sensing, phone: (383)343-29-11, e-mail: btmazurov@mail.ru

From the point of view of mathematical support in a variety of geodetic projections, noted the overwhelming predominance of the projections obtained on the basis of the theory of conformal mappings of surfaces. Assessment of the geodetic projections' merits takes into account their accuracy, computation ease and the magnitude of the distortion of the ellipsoid metric elements displayed on a plane. For carrying out geodetic and topographical surveys, engineering surveys, construction and operation of buildings and structures, land surveying, cadastre and the implementation of other special works it is necessary to ensure the production of more accurate coordinates.

This article gives the results calculations experiments comparing several geodetic projections. For a scale of 1 : 1 000 000 was studied linear distortion when using a transverse cylindrical projection Gauss-Krüger, UTM, Lambert conical, Gauss stereographic. Similar calculations were performed for larger scales of 1 : 50 000 and larger. Best in the sense of magnitude of linear distortions were determined by the local transverse cylindrical and Gauss stereographic. The necessity for projection on the section plane to mountainous areas was confirmed. There were given the recommendations on choosing the optimal special geodetic projection.

Key words: engineering and geodetic works, special geodetic projection, linear distortion, mountainous terrain.

REFERENCES

1. Krasovskij, F. N. (1942). *Rukovodstvo po vysshej geodezii: Ch. II [Manual of higher geodesy: Part II]*. Moscow: Geodezizdat [in Russian].
2. Mazurov, B. T., Nikolaeva, O. N., & Romashova, L. A. (2012a). Integrated environmental maps as a tool to study the dynamics of the environmental situation industrial center. *Izvestija vuzov. Geodeziya i aerofotos"emka [Izvestija Vuzov. Geodesy and Aerophotography]*, *2-1/S*, 88–95 [in Russian].
3. Mazurov, B. T., Nikolaeva, O. N., & Romashova, L. A. (2012b). Improving the information base for a regional GIS (RGIS) inventory and mapping of resources. *Izvestija vuzov. Geodeziya i aerofotos"emka [Izvestija Vuzov. Geodesy and Aerophotography]*, *2-1/S*, 130–135 [in Russian].
4. Panzhin, A. A., Sashurin, A. D., Panzhina, N. A., & Mazurov, B. T. (2016). Geodesic support of geodynamic monitoring of objects of subsurface use. *Vestnik SSGA [Vestnik SSGA]*, *4*(36), 26–29 [in Russian].
5. Mazurov, B. T., Pankrushin, V. K., & Seredovich, V. A. (2004). Mathematical modeling and identification of the stress-deformed state of geodynamic systems in the aspect of forecast of natural and technogenic catastrophes. *Vestnik SGUGiT [Vestnik SSUGT]*, *9*, 30–35 [in Russian].

6. Gauss, K. F. (1958). *Izbrannye geodezicheskie sochinenija: T. 1. [Selected geodetic works: Vol. 1]*. G. V. Bagratuni (Ed.). Moscow: Geodizdat [in Russian].

7. Krueger, L. (1912). *Konforme Abbildung des Erdellipsoids in der Ebene*, New Series 52. Potsdam: Royal Prussian Geodetic Institute. doi: 10.2312/GFZ.b103-krueger28.

8. Bugayevskiy, M., & Snyder, J. P. (1995). *Map Projections: A Reference Manual*. London: Taylor & Francis. Retrived from http://www.worldcat.org/oclc/31737484.

9. Morozov, V. P. (1979). *Kurs sferoidicheskoj geodezii [Course sparodically geodesy]*. Moscow: Nedra [in Russian].

10. Code of Practice. (2013). *CP 47.13330.2012. Engineering surveys for construction. Basic provisions*. Updated version of CNaR 11-02-96. Intr. 07.01.2013. Moscow: Minregion of Russia. Retrieved from ConsultantPlus online database [in Russian].

11. Poshivajlo, Ja. G., Chahlova, A. P., & Ustavich G. A. (2013). Create topographic information system for the purpose of designing engineering structures in the mountains. *Geodezija i kartografija [Geodesy and Cartography]*, *3*, 17–21 [in Russian].

12. Ustavich, G. A., Chahlova, A. P., & Poshivajlo, Ja. G. (2015). The Creation of engineering topographic plans for design objects in the highlands. *Izvestija vuzov. Geodeziya i aerofotos"emka [Izvestija Vuzov. Geodesy and Aerophotography]*, *5*, 183–188 [in Russian].

13. Ustavich, G. A. (2006). The need for the creation of topographic maps of scale 1:250, 1:200 and 1:100. *Geodezija i kartografija [Geodesy and Cartography]*, *3*, 25–28 [in Russian].

14. Zenin, V. N. (1968). The question of the choice of geodesic the projection to geodetic engineering works. *Izvestija vuzov. Geodeziya i aerofotos"emka [Izvestija Vuzov. Geodesy and Aerophotography]*, *6*, 23–29 [in Russian].

15. Vinogradov, A. V. (2010). Improving the accuracy of the calculation of land area to built-up areas. *Geodezija i kartografija [Geodesy and Cartography]*, 9, 10–13 [in Russian].

16. Lambert, J. H. (1772). *Beytragezum Gebrauche der Mathematik und der en AnwendungIII: Part VI, Anmerkungen und ZusatzezurEntwerfung der Land-und Himmelscharten* (pp. 105–199). Retrived from http://books.google.com/books?id=sf82AAAAMAAJ.

17. Gauss, C. F. (1903). *Carl Friedrich Gauss Werke*: *Vol. 9*. Ges. Wiss., Göttingen.

18. *Basic provisions for the creation and updating of topographic map scales 1 : 10 000, 1 : 25 000, 1 : 50 000, 1 : 100 000, 1 : 200 000, 1 : 500 000, 1 : 1 000 000.* (1984). Moscow: RIO VTS [in Russian].

19. *Basic provisions for the creation of topographic plans of scales 1 : 5 000, 1 : 2 000, 1 : 1 000, 1 : 500*. (1979). Moscow: GUGK [in Russian].

20. *Instruction on topographic surveys in scale 1 : 10 000–1 : 25 000*. (1978). Moscow: Nedra [in Russian].

21. *Instruction on topographic surveys in scale 1 : 5 000–1 : 500*. (1982). Moscow: Nedra [in Russian].

22. Zenin, V. N. (1970). The development of special geodetic projected engineering and urban surveying. *Extended abstract of candidate's thesis*. Moscow [in Russian].

23. Abzhaparova, D. A. (2014). Mathematical processing of geodetic engineering networks in the stereographic projection of the Gauss. *Vestnik SSGA [Vestnik SSGA]*, *2*(26), 27–32 [in Russian].

24. Abzhaparova, D. A. (2016). Processing of special geodetic networks in the projection of the section plane (on the example of Kirov reservoir in the Kyrgyz Republic). *Vestnik SGUGiT [Vestnik SSUGT]*, *2*(34), 14–23 [in Russian].

25. Abzhaparova, D. A. (2016). The development of a special variant of the projection Gauss – Krüger engineering for urban geodetic works in the Republic of Kyrgyzstan. *Vestnik SGUGiT [Vestnik SSUGT]*, *3*(35), 27–34 [in Russian].

Received 15.03.2017

ANALYSIS OF THE DEFORMATIONS OF THE GROUND SURFACE ON STEPNOVSKAYA UNDERGROUND GAS STORAGE BY METHODS OF SATELLITE AND GROUND-BASED GEODESY

Svetlana S. Kwiatkowska
Gazprom UGS, 117420, Russia, Moscow, 12A Nametkina St., Deputy Chief of Surveyor Services, phone: (495)428-41-00, e-mail: s.kvyatkovskaya@phg.gazprom.ru

Yuriy O. Kuzmin
Schmidt Institute of Physics of the Earth of the Russian Academy of Sciences, 123242, Russia, Moscow, 10-1 Bolshaya Gruzinskaya St., Dr. Sc., Professor, Head of the Laboratory of Recent and Applied Geodynamics, phone: (499)254-65-65, e-mail: kuzmin@ifz.ru

Roman S. Nikitin
Gazprom UGS, 117420, Russia, Moscow, 12A Nametkina St., Deputy General Director, Chief Geologist, phone: (495)428-45-01, e-mail: R.Nikitin@phg.gazprom.ru

Evgeniy A. Fattakhov
Schmidt Institute of Physics of the Earth of the Russian Academy of Sciences, 123242, Russia, Moscow, 10-1 Bolshaya Gruzinskaya St., Junior Staff Scientist, phone: (499)254-65-65, e-mail: Fea@ifz.ru

For rational subsoil use on underground gas storage (UGS) geodynamic polygons are created. On these ranges, repeated geodetic (ground-based and satellite) observations of deformations of the earth's surface are carried out.

Stepnovskoe UGS has conducted 4 cycles of repeated observations, corresponding to the operation regime (injection and selection of gas for 1 year). To measure the vertical displacements of the earth's surface, grade 2 was applied, and horizontal displacements were determined by GNSS observations.

Analysis of the results of leveling observations showed the presence of local deformations of the earth's surface in fault zones with the rates of relative deformations - $2\text{-}3 \cdot 10^{-5}$ per year. The results of measuring horizontal displacements revealed their ambiguity. It follows from the fundamentals of geomechanics that horizontal displacements are much smaller than vertical ones in the central part of the reservoir or in the center of the fault zone. This is not observed in all cycles of repeated observations. It is proposed to use ground-based tacheometric observations for the measurement of horizontal displacements of fault zones in the form of building local trilateration networks.

Key words: geodynamic polygon, underground gas storage, ground-based and satellite measurement methods, the deformations of the earth surface, fault zone, trilateration network.

REFERENCES

1. Guidance Document. (2003). Instructions for the production of mine surveying (GD 07-603-03). Moscow [in Russian].

2. Pevzner, M. E., & Popov, V. N. (Ed.). (2003). *Markshejderija [Mine surveying]*. Moscow: MSMU [in Russian].

3. Kuzmin, Yu. O. (2008). Problematic issues of studying the deformation processes in recent geodynamics. *Gornij informationij-analyticheskij bulletin [Mountain Information and Analytical Bulletin]*, *3*, 98–107 [in Russian].

4. Grunin, A. G., Kuzmin, Yu. O., & Fattakhov, E. A. (2014). Problematic issues of design of geodynamic grounds on UV fields. *Markshejderskij vestnik [Mine Surveying Bulletin]*, *6*, 24–31 [in Russian].

5. Kuzmin, Yu. O. (2014). The topical problems of identifying the results of the observations in recent geodynamics. *Izvestiya. Physics of the Solid Earth*, *50*(5), 641–654.

6. Nikonov, A. I. (2006). The problem of the imperfection of the geological models and optimize the development of hydrocarbon fields and underground gas storage facilities. In *Sbornik materialov GEO-Sibir'-2006: T. 3, ch. 1 [Proceedings of GEO-Siberia-2006: Vol. 3, Part 1]* (pp. 203–211). Novosibirsk: SSGA [in Russian].

7. Kravcov, V. V., Nikonov, A. I., & Jurova, M. P. (1999). The role of geodynamics in the formation of spatio-temporal heterogeneity of the geological environment geoenvironmental risk factors (by the example of Kasimov structure). In *Perspektivy razvitija jekologicheskogo strahovanija v gazovoj promyshlennosti [Prospects of environmental insurance development in the gas industry]* (pp. 351–369). Moscow: VNIIGAZ [in Russian].

8. Kuzmin, Yu. O. (2014). Recent geodynamics of fault zones: faulting in real time scale. *Geodynamics & Tectonophysics*, *5*(2), 401–443 [in Russian].

9. Kuzmin, Yu. O. (2016). Recent geodynamics of dangerous faults. *Izvestiya. Physics of the Solid Earth*, *52*(5), 709–722.

10. Kuzmin, Yu. O. (2015). Recent geodynamics of a fault system. *Izvestiya. Physics of the Solid Earth*, *51*(4), 480–485.

11. Kuzmin, Yu. O. (2004). Geodynamic risk. In *Rossijskaja Gazovaja Jenciklopedija [Russia's Gas Encyclopedia]* (pp. 121–124). Moscow: Great Russian Encyclopedia [in Russian].

12. Dzurisin, D. (2007). *Volcano deformation. Geodetic monitoring techniques*. UK: Springer.

13. Kuzmin, Yu. O., & Fattakhov, E. A. (2016). Analysis of deformation of the earth's surface on stepnovskaya underground gas storage. *In Sbornik materialov Chetvertoy tektonofizicheskoy konferencii v IFZ RAN, Tektonofizika i aktual'nye voprosy nauk o Zemle, materialy dokladov vserossijskoj konferencii s mezhdunarodnym uchastiem [Proceedings of the Fourth Tectonophysical Conference in IPE RAS, Tectonophysics and Actual Problems of Earth Sciences, Proceedings of All-Russian Conference with International Participation]* (pp. 102–107). Moscow: IPE RAS [in Russian].

14. Castelletto, N., Ferronato, M., Gambolati, G., Janna, C., Teatini, P., Marzorati, D., & Cairo E. et. al. (2010). 3D geomechanics in UGS projects. A comprehensive study in northern Italy. *44th US rock mechanics symposium and 5th U. S. Canada rock mechanics symposium.*

Received 03.05.2017

DETERMINATION OF ROAD SURFACE EVENNESS INDEX BASED ON MOBILE LASER SCANNING

Vladimir A. Seredovich
Novosibirsk State University of Architecture and Civil Engineering, 630008, Russia, Novosibirsk, 113 Leningradskaya St., Professor, Head of Scientifically-Research Works Department, phone: (383)266-25-27, e-mail: v.seredovich@li st.ru

Maxim A. Altyntsev
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotonogo St., Ph. D., Associate Professor, Department of Engineering Geodesy and Mine Surveying, phone: (952)915-29-80, e-mail: mnbcv@mail.ru

Alexander K. Egorov
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D. Student, Department of Engineering Geodesy and Mine Surveying, phone: (913)946-36-22, e-mail:biganot81@mail.ru

The article examines method of determining evenness of the road surface based on the patent RU 2509978 – the method of determining the road surface irregularities.

We have considered global and national experience of determining evenness of the road surface, so we can match the following research (scientific) centers and their members who practice this concept (area of focus) : Novosibirsk (Russia: Seredovich V.A., Altynsev M.A., Komissarov A.V., Ivanov A.V.), Tomsk (Russia, Motuz V.O., Sarychev D.S.), Saint-Petersburg (Russia, Bochkarev N.N.), Kharkov (Ukraine, Gorb A.A., Gorb A.I.), Canada (Dave Hugelschaffer, I. Puente, Daina_Morgan), Taiwan (Jia-Ruey Chang, Yung-Shuen Su, Tsun-Cheng Huang, Shih-Chung Kang), Oregon (USA: Michael J. Olson, Abby Chin) etc. The novelty in the considered method is new algorithm of obtaining the data. By means of point cloud, which we have discovered by using mobile laser scanning, making balancing of scans and filtering the noise of point clouds, were performed measurements of gleams of a road surface under a virtual leveling rod. These measurements were used to researching on calculation of the international index of evenness IRI. As a result, we found that mobile laser scanning is a reliable and valid data source, which are used to determine evenness of the road surface.

Further it is planned to make the calculation of the index of evenness IRI, using the digital surface model from the mobile laser scanning data, to select the most valid data of determining index of evenness.

Key words: mobile laser scanning, point cloud, evenness, road surface, International Roughness Index (IRI), rail, determining the evenness of the pavement, accuracy assessment.

REFERENCES

1. Olsen, M. J., Roe, G. V., Glennie, C., Reedy, M., Hurwitz, D., Williams, K., Tuss, H., Squellati, A., & Knodler, M. (2013). *Guidelines for the Use of mobile LIDAR in Transportation Applications*. Retrieved from www.TRB.org.

2. Rukovodstvo po otsenke rovnosti dorozhnykh pokrytiy tolchkomerom *[Guidance on the assessment of evenness of road surfaces by talamera]*. (2002). Moscow: the Russian Federation state service of road economy [in Russian].

3. Pavement Interactive International Roughness Index (IRI). (2007). Retrieved from http://www.pavementinteractive.org/article/roughness.

4. Apestin, V. K., Balovnev, V. I., Belov, V. D., Borisyuk, N. V., Zhilin, S. N., & Goryachev, M. G. (2004). *Spravochnaya entsiklopediya dorozhnika: T. 2, Remont i soderzhanie avtomobil'nykh dorog [Reference encyclopedia road maintenance: Vol. 2, Repair and maintenance of roads]*. Vasil'ev A. P. (Ed.). *Moskow* [in Russian].

5. Gorb, A. A., & Gorb, A. I. (2009). Defention of evenness index by method of ground-based laser scanning. *Inzhenerna geodeziya [Engendering Geodesy]*, *1*(36), 145–149 [in Ukrain].

6. Chang, J. R., Su, Y. Sh., Huang, Ts. Ch., Kang, Sh. Ch., & Hsieh, Sh. H. (2009). Measurement of the International Roughness Index (IRI) Using an Autonomous Robot (P3-AT). *26th International Symposium on Automation and Robotics in Construction*, 325 p.

7. Motuz, V. O., & Sarychev, D. S. (2014). Applications of lidar mapping and 3D models in road lifecycle. *SAPR i GIS avtomobilnykh dorog [CAD and GIS Roads]*, *1*(2), 12–15 [in Russian].

8. Seredovich V. A., Seredovich A. V., & Ivanov A. V. *Patent RF No. 2509978*. Novosibirsk: IP Russian Federation.

9. *Standarts Russian Federation. (2005). Klassifikatsiya avtomobil'nykh dorog. Osnovnye parametry i trebovaniya (GOST 52398-2005) [Classification of automobile roads. Basic parameters and requirements]*. Moscow: Author [in Russian].

10. Standarts Russian Federation. (2005). *Geometricheskie element avtomobil'nykh dorog. (GOST 52399-2005) [Geometric elements of highways]*. Moscow: Author [in Russian].

11. Standarts Russian Federation. (2000). *Dorogi avtomobil'nye i aerodromy. Metody izmereniy nerovnostey osnovaniy i pokrytiy (GOST 30412-96) [Roads and aerodromes. Methods for measuring the unevenness of bases and coatings]*. Moscow: Author [in Russian].

12. Baygulov, A. N., Romaneskul, M. A., Shumilov, B. M., & Gubskaya, M. M. (2013). The method of road repair designing based on mobile lidar mapping. *SAPR i GIS avtomobilnykh dorog [CAD and GIS Roads]*, *1*(1), 29–32 [in Russian].

13. Voroshilov, A. P., & Karachentsev, Y. A. (2011). Surveying the cracks at surface laser scanning of buildings and constructions. *Bulletin of the South Ural State University [Bulletin of the South Ural State University]*, *16*(233), 11–14 [in Russian].

14. Seredovich, V. A., Seredovich, A. V., & Ivanov, A. V. (2010). Terrestrial laser scanning application for the control over the highways construction and major repair. In *Sbornik materialov GEO-Sibir'-2010: T. 1, ch. 3 [Proceedings of GEO-Siberia-2010: Vol. 1, Part 3]* (pp. 69–72). Novosibirsk: SSGA [in Russian].

15. Seredovich, V. A., Altyntsev, M. A., & Popov, R. A. (2014). The choice of mobile laser scanning data adjustment technique subject to obtained data quantity of surveyed area. In *Sbornik materialov Interekspo GEO-Sibir'-2015: Mezhdunarodnoy nauchnoy konferentsii: T. 2. Geodeziya, geoinformatika, kartografiya, marksheyderiya [Proceedings of Interexpo GEO-Siberia-2014: International Scientific Conference: Vol. 2. Geodesy, Geoinformation, Mapping, Main Survey]* (pp. 142–149). Novosibirsk: SSGA [in Russian].

16. Seredovich, V. A., & Altyntsev, M. A. Application of mobile laser scanning data for creation of topographic plans. In *Sbornik materialov Interekspo GEO-Sibir'-2013: Mezhdunarodnoy nauchnoy konferentsii: T. 3. Geodeziya, geoinformatika, kartografiya, marksheyderiya. [Proceedings of Interexpo GEO-Siberia-2013: International Scientific Conference: Vol. 3. Geodesy, Geoinformation, Mapping, Main Survey]* (pp. 96–100). Novosibirsk: SSGA [in Russian].

17. Komissarov, A. V. (2015). Teoriya i tekhnologiya lazernogo skanirovaniya dlya prostranstvennogo modelirovaniya territoriy [Theory and technology of laser scanning for spatial modeling territories]. *Extended abstract of Doctor's thesis*. Novosibirsk [in Russian].

Received 18.04.2017

HIGH PRECISION GEODETIC MEASUREMENTS AT DEFORMATION MONITORING OF AQUAPARK

Andrei A. Sholomitsky
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Professor, Department of Engineering Geodesy and Surveying Business, phone: (383)343-29-55, e-mail: sholomitskij@mail.ru

Elena K. Lagutina
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Senior Teacher, Department of Engineering Geodesy and Surveying Business, phone: (383)343-29-55, e-mail: e.k.lagutina@ssga.ru

Ekaterina L. Soboleva
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Associate Professor, Department of Engineering Geodesy and Surveying Business, phone: (383)343-29-55, e-mail: e.l.soboleva@mail.ru

The article considers the urgency and problems of geodetic monitoring of large-span structures under construction and the methods of monitoring used. A description of the design of

the object under construction and the geotechnical characteristics of the soil at the construction site are given. The article proves the method of precision geodetic works in monitoring the state of buildings and structures of Aquapark Novosibirsk. The measurements were carried out by on-line measuring complex "Vizir 3D". Data accuracy precalculation of geodetic networks and practical application of the complex by high-precision measurements are provided. Correlation of deformations of reinforced concrete structures and ambient temperature is revealed. To account for the change in the object when the environmental parameters are changed, it is proposed to create a complex model of the object that takes into account these parameters. Problems which require the solution are defined. Using the online geodetic complex "Vizir 3D" allowed to significantly reduce the time of field and computational work and improve the accuracy of measurements.

Key words: building, installing, monitoring, modeling, geodetic measurements, accuracy precalculation.

REFERENCES

1. Shumeyko, V. I., & Kudinov, O. A. (2013). On the design features a unique, long-span and high-rise buildings and structures. *Inzhenernyy vestnik Dona [Engineering Journal of Don]*, *4*(27), 281 p. Retrieved from: http://elibrary.ru/item.asp?id=21452385 [in Russian].

2. Shakhraman'yan, A. M., & Kolotovichev, Yu. A. (2015). Experience of using automated monitoring systems of the strain state of bearing structures on the olympic objects Sochi-2014. *Vestnik MGSU [Vestnik MGSU], 12*, 92–105 [in Russian].

3. Gurjev, V. V., Dorofeev, V. M., & Strazhnikov A. M. (2007). The problems of safe operation of large-span buildings and structures. *Promyshlennoe i grazhdanskoe stroitelstvo [Industrial and Civil Engineering]*, *5*, 35–36. Retrieved from http://www.pgs1923.ru/russian/rindex.htm [in Russian].

4. Mogilny, S. G., Sholomitsky, A. A., & Shmorgun, E. I. (2010). Automated system project of geodetic monitoring for stadiums. *Naukovi praci Donec'kogo nacional'nogo tehnichnogo universytetu. Serija: Girnycho-geologichna [Proceedings of Donetsk National Technical University. Series: Mining and Geology]*, *12*(173), 3–14 [in Russian].

5. Guidance Documentation in Construction. (2010). *Metodika geodezicheskogo monitoringa tekhnicheskogo sostoyaniya vysotnykh i unikal'nykh zdaniy i sooruzheniy (MDS 13-22.2009) [Methods of geodetic monitoring of a technical condition of high-rise and unique buildings and structures]*. Retrieved from http://docs.cntd.ru/document/415921552 [in Russian].

6. Guidance Documentation in Construction. (2008). *Posobie po nauchno-tekhnicheskomu soprovozhdeniyu i monitoringu stroyashchikhsya zdaniy i sooruzheniy, v tom chisle bol'sheproletnykh, vysotnykh i unikal'nykh (MRDS 02-08) [Handbook for scientific and technical support and monitoring of buildings and structures under construction, including large-span, high-rise and unique structures and buildings]*. Retrieved from http://www.gostrf.com/normadata/1/4293834/4293834435.pdf [in Russian].

7. Rulebook. (2011). *Osnovaniya zdaniy i sooruzheniy (SP 22.13330.2011) [Soil bases of buildings and structures]*. Retrieved from at: http://docs.cntd.ru/document/1200084710 [in Russian].

8. Code of practice. (1997). *Inzhenerno-geodezicheskie izyskaniya dlya stroitel'stva (SP 11-104-97) [Engineering geodesical survey for construction]*. Retrieved from http://docs.cntd.ru/document/871001219 [in Russian].

9. Rulebook. (2012). *Nesushchie i ograzhdayushchie konstruktsii (SP 70.13330.2012) [Load-bearing and separating constructions]*. Retrieved from http://docs.cntd.ru/document/1200097510 [in Russian].

10. Rulebook. (2012). *Inzhenernye izyskaniya dlya stroitel'stva. Osnovnye polozheniya (SP 47.13330.2012) [Engineering survey for construction. Basic principles]*. Retrieved from http://docs.cntd.ru/document/1200096789 [in Russian].

11. Building codes and regulations (2001). *Bezopasnost' truda v stroitel'stve: Chast' 1, Obshchie trebovaniya (SNiP 12-03-2001) [Job safety in construction: Part 1, General requirements]*. Retrieved from http://www.tehbez.ru/Docum/DocumShow_DocumID_306.html. [in Russian].

12. Geodesic, cartographic instructions, standards and rules. (2004). *Instrukcija po nivelirovaniju I, I, III i IV klassov (GKINP (GNTA)-03-010-03) [Manual leveling I, II, III and IV classes]*. Moscow: CNIIGAIK [in Russian].

13. State standard. (2012). *Grunty. Metody izmereniya deformatsiy osnovaniy zdaniy i sooruzheniy (GOST 24846-2012) [Soils. Measuring methods of strains of structures and building bases]*. Retrieved from http://docs.cntd.ru/document/gost-24846-2012 [in Russian].

14. Rulebook. (2011). *Nagruzki i vozdeystviya (SP 20.13330.2011) [Loads and actions]*. -Retrieved from http://dokipedia.ru/document/5140596 [in Russian].

15. Moscow city's construction standards. (2005) *Vremennye normy i pravila proektirovaniya mnogofunktsional'nykh vysotnykh zdaniy i zdaniy-kompleksov v gorode Moskve (MGSN 4.19-2005) [Temporary norms and rules for design of multifunctional high-rise buildings and complexes of buildings in Moscow]*. Retrieved from http://ohranatruda.ru/ot_biblio/normativ/data_normativ/46/46475/ [in Russian].

16. State Standard. (2011). *Zdaniya i sooruzheniya. Pravila obsledovaniya i monitoringa tekhnicheskogo sostoyaniya (GOST 31937-2011) [Buildings and constructions. Rules of inspection and of the technical condition]*. Retrieved from http://www.spbgasu.ru/upload-files/users/iastahov/norm/GOST_31937-2011_.pdf [in Russian].

17. Gorpinchenko, V. M., & Yegoroy, M. I. (2006). Monitoring the technical conditions of structures used for socially- significant large-span buildings in Moscow. *Promyshlennoe i grazhdanskoe stroitelstvo [Industrial and Civil Engineering]*, *8*, 16–19 [in Russian].

18. Lambrou, E., Pantazis, G., & Nikolitsas, K. (2008). Special Marking of 3D Networks' Points for the Monitoring of Modern CONSTRUCTIONS. *Proceedings of 13th FIG Symposium on Deformation Measurement and Analysis & 4th IAG Symposium on Geodesy for Geotechnical and Structural Engineering* (pp. 1–10). Portugal: Lisbon.

19. Novikov, V. J. (2014). The application of deformation monitoring to prevent accidents of industrial facilities. *Ekologiya i promyshlennost' Rossii [Ecology and Industry of Russia]*, *2*, 46–48 [in Russian].

20. Boldyrev, G. G., & Zhivaev, A. A. (2013). Geotechnical monitoring. *Inzhenernye izyskaniya [Engineering Surveys]*, *10–11*, 22–27 [in Russian].

21. Stuntsaiger, I., Lysov, D., Denisov, A., Slobodenyuk, A., & Kugachev, A. (2015). Device practice of stationary automated monitoring systems of constructions on the Olympic sites in Sochi. *Stroitel'stvo i rekonstruktsiya [Building and reconstruction]*, *4*(60), 67–71 [in Russian].

22. Markov, S. V., Galubka, A. I., & Sinyutin, A. V. (2014). Automated monitoring of the bearing constructions of large-span buildings. *Nauchnoe obozrenie [The Scientific Review]*, 7–1, 125–129 [in Russian].

23. Bogdanets, E. S., & Cheryomukhina, O. O. (2014). Research in deformation processes with the application of automatic monitoring system. *Master's Journal [Master's Journal]*, *1*, 82–90 [in Russian].

24. Hiller, B., Li, V. T., & Sukhov, I. V. (2014). Automated deformation monitoring system (ASDM) at the Sayano-Shushenskaya HPP. *Inzhenernaya zashchita [Engineering Protection]*, *4*(4), 36–43 [in Russian].

25. Dorofeev, V. M., Lisov, D. A., & Denisov, A. S. (2011). Features of Design of Automated Stationary Systems for Monitoring of Technical State of Bearing Structures of Long-Span Sports Facilities of Olympic Games-2014 in Sochi. *Promyshlennoe i grazhdanskoe stroitel'stvo [Industrial and Civil Engineering]*, *12*, 46–48 [in Russian].

26. Guriev, V. V., Dorofeev, V. M., Lisov, D. A, & Nazmov, N. V. (2011). Automated inspection of structural safety of high-rise and wide-span unique buildings. *Stroitel'naya mekhanika inzhenernykh konstruktsiy i sooruzheniy [Structural Mechanics of Enginiring Constructions and Buildings]*, *2*, 55–61 [in Russian].

27. Glavinsky, D. V. (2011). Methods of the roofs constructions` automated monitoring in the Ice Palace "Uralskaya Molniya". *Monitoring. Nauka i bezopasnost' [Monitoring. Science and Safety]*, *3*, 64–68 [in Russian].

28. Nikonov, A. V., & Babasov, S. A. (2013). Research of trigonometric leveling in field conditions. In *Sbornik materialov Interekspo GEO-Sibir'-2013: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodeziya, geoinformatika, kartografiya, markshejderiya [Proceedings of Interexpo GEO-Siberia-2013: International Scientific Conference: Vol. 1. Geodesy, Geoinformatics, Cartography, Mine surveying]* (pp. 71–77). Novosibirsk: SSUGT [in Russian].

29. Ustavich, G. A., Nikonov, A. V., & Babasov, S. A. (2014). Methods of inverse trigonometric leveling. In *Sbornik materialov Interekspo GEO-Sibir'-2014: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodeziya, geoinformatika, kartografiya, markshejderiya [Proceedings of Interexpo GEO-Siberia-2014: International Scientific Conference: Vol. 1. Geodesy, Geoinformatics, Cartography, Mine surveying]* (pp. 51–56). Novosibirsk: SSUGT [in Russian].

30. Mogilny, S. G., & Sholomitsky, A. A. (2011). Software for underground mine networks. *Ugol' Ukrainy [Coal of Ukraine]*, *5*, 17–22 [in Russian].

31. Mogilny, S. G., Sholomitsky, A. A., & Revutsky, V. A. (2009). Software "Vizir 3D" at the enterprises of Ukraine: Geodetic control and reconciliation process equipment. *Geoprofil' [Geoprofil]*, *3*(6), 12–19 [in Russian].

32. Safety regulations. (2002). *Pravila bezopasnosti pri ekspluatatsii dymovykh i ventilyatsionnykh promyshlennykh trub (PB 03-445-02) [Guide to Operation of Industrial Smokestacks and Ventilation Pipes]*. Retrieved from http://www.volgograd-vdpo.ru/file/rule_smogpipe.pdf [in Russian].

Received 20.06.2017

PROFILE-M HARDWARE AND SOFTWARE SUITE FOR DETERMINING THE SPATIAL AND GEOMETRIC PARAMETERS OF THE TRACK GAUGE

Ivan V. Shcherbakov
Siberian Transport University, 630049, Russia, Novosibirsk, 191 D. Kovalchuk St., Leading Engineer of the Research Laboratory for Diagnostic of Road Surfacing and Roadbed, phone: (913)795-33-33, e-mail: sibdorproect@bk.ru

Engineering and geodesic support of design and survey works, construction and operation is performed with the use of geodetic instruments and equipment.

Geodetic instruments and equipment are universal as they are used in various spheres of production; a line of instruments and equipment ensures the required precision of measurements within the set range. However, it is impossible to complete some engineering and geodesic tasks efficiently with the use of typical equipment. Such tasks are, as a rule, specific: for example, determining the geometric parameters of the rail based on spatial data.

A method, a device and a technique for determining geometric parameters created with the help of Profile-M hardware and software suite are proposed. The Profile-M suite is based on determining spatial data and geometric parameters of the rail by the use of only GNSS.

The paper deals with the problems of geodetic control at railways, with the specific character and peculiarities of railway engineering problems and their solutions, and with the principal guidelines for facilities and methods development of geodetic control and the standard of its improvement at railways of RZD Corporation.

Key words: GNSS, satellite positioning equipment, Profile-M hardware and software suite, geometric parameters of rail, railway, technologies based on geoinformation system, location and geometrics, track alignment control system, automatic control systems.

REFERENCES

1. Shcherbakov, V. V. A method of determining spatial parameters of the rail and the device to do it. *Patent RF No. 2261302*. IP Russian Federation [in Russian].
2. Shcherbakov, V. V. (2013). Track Alignment During the Reconstruction and Repair of Railway with the Use of GIS-Technologies and GNSS. In *Sbornik materialov Interekspo GEO-Sibir'-2013: Mezhdunarodnoy nauchnoy konferentsii: T. 3.* Geodeziya, geoinformatika, kartografiya, marksheyderiya *[Proceedings of Interexpo GEO-Siberia-2013: International Scientific Conference: Vol. 3. Geodesy, Geoinformatics, Cartography, Mine Surveying]* (pp. 14–20). Novosibirsk: SSUGT [in Russian].
3. Shcherbakov V. V., Kovaleva O. V., & Shcherbakov I. V. (2016). Digital Tracks Models Are the Basis For Geodetic Support of Railway Construction (Repair) and Operation. *Geodeziya i kartografiya [Geodesy and Cartography]*, *3*, 12–16 [in Russian].
4. Shcherbakov V. V., & Shcherbakov I. V. (2015). Development of Systems for Computer-Assisted Management of Track Surfacing Based on GNSS. *Transportnoe stroitel'stvo [Transport Construction]*, *9*, 22–25 [in Russian].
5. Shcherbakov V. V., & Shcherbakov, I. V. (2014). Analysis of methods of placing the tracks in-situ during the reconstruction (reengineering) and operation. In *Sbornik materialov Interekspo GEO-Sibir'-2014: Mezhdunarodnoy nauchnoy konferentsii: T. 1. Geodeziya, geoinformatika, kartografiya, marksheyderiya [Proceedings of Interexpo GEO-Siberia-2014: International Scientific Conference: Vol. 1. Geodesy, Geoinformatics, Cartography, Mine Surveying]* (pp. 87–92). Novosibirsk: SSUGT [in Russian].
6. Vereskun, V. D., Gerasimov, V. A., Shcherbakov, V. V., & et al. Device for determining spatial parameters of railway infrastructure facilities. *Patent RF No. 116862*. IP Russian Federation [in Russian].
7. Shcherbakov, V. V., Shcherbakov I. V., Modestov, A. N., Buntsev, I. A., & Slavkin, V. P. Device for straightening railway tracks. *Patent RF No. 136048*. IP Russian Federation [in Russian].
8. Shcherbakov V. V., Modestov A. N., Vereskun V. D., Pikalov A. S. Track machine. *Patent RF No. 112209*. IP Russian Federation [in Russian].
9. Shcherbakov V. V., Modestov A. N., Vereskun V. D., & Pikalov A .S. *Patent RF No. 126011*. IP Russian Federation [in Russian].
10. Kulizhnikov, A. M. Anufriev, A. A., & Kolesnikov, I. P. (2014). Normative base for automatic control systems 3D. *SAPR i GIS avtomobil'nykh dorog [CAD & GIS for Roads]*, *2*, 38–41 [in Russian].
11. The Order of JSC Russian Railways of December 31, 2015 No. 3214. Retrieved from ConsultantPlus online database [in Russian].
12. Skvortsov, A. V. (2014). Normative and technical support of BIM highways. *SAPR i GIS avtomobil'nykh dorog [CAD & GIS for Roads]*, *2*, 22–32 [in Russian].

Received 22.06.2017

CARTOGRAPHY AND GEOINFORMATICS

THEORETICAL BASIS AND FEATURES OF MULTIMEDIA CARTOGRAPHY

Dmitry V. Lisitsky
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St, Dr. Sc., Professor, Director, Research Institute of Strategic Development, phone: (383)344-35-62; e-mail: nii@ssga.ru

Elena V. Komissarova
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Associate Professor, Department of Cartography and Geoinformatics, phone: (913)710-85-60, e-mail: komissarova_e@mail.ru

Alexey A. Kolesnikov
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St, Ph. D., Senior Lecturer, Department of Cartography and Geoinformatics, phone: (913)725-09-28, e-mail: alexeykw@mail.ru

Computerization has led to a change of destination, the subject of research, the methods and technologies in cartography, and resulted in the development of a new direction - a multimedia cartography. The article describes the advantages of this trend, considered the concept, properties and attributes. Are considered and formalized the essence of the two-dimensional static, three-dimensional static and multimedia maps as well as a particular case of the last one - two-dimensional and three-dimensional animation maps. For the first time a multimedia map is presented in the form of a set whose elements are map items. Also considered individual components of the multimedia maps: scale, generalization, mathematical basis and system of mapping symbols.

Key words: multimedia cartography, concept, formalization, two-dimensional map, three-dimensional map, animation map, generalization, system of mapping symbols.

REFERENCES

1. Castells, M. (1998). *The Information age: economy, society and culture: Vol. III, The end of millennium*. Malden (Ma), Oxford.

2. Ronchi, A. M. (2009). *E-Culture*. New York: Springer–Verlag, LLC.

3. Lisitsky, D. V. (2013). Prospects for cartography development: from digital land to virtual georeality. *Vestnik SGGA [Vestnik SSGA]*, 2(22), 8–16 [in Russian].

4. Cartwright, W., Peterson, M. P., & Gartner, G. (Eds.). (2007). *Multimedia cartography* (2nd ed.). Berlin: Springer-Verlag.

5. Peterson, M. P., Cartwright, W., & Gartner G. (Eds.). (2007). *The internet and multimedia cartography*. *Multimedia cartography* (2nd ed.). Berlin: Springer-Verlag.

6. Ormeling, F., (2007). Map Concepts in Multimedia Products. In W. Cartwright, M. P. Peterson, G. Gartner (Eds.), *Multimedia Cartography* (2nd ed.). Berlin: Springer–Verlag.

7. Taylor, F., & Lauriault, T. P. (2007). *Future directions for multimedia cartography*. In: W. Cartwright, M. P. Peterson, G. Gartner (Eds.), *Multimedia cartography* (2nd ed.). Berlin: Springer-Verlag.

8. Stopper R., Sieber R., Schnabel O. *Introduction to multimedia cartography*. Retrieved from http://www.e-cartouche.ch.

9. Lisitsky, D. V., Kolesnikov, A. A., Komissarova, E. V., Bugakov, P. Ju., & Pisarev, V. S. (2014). Multimedia direction in cartography. *Izvestia vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *3*, 40–44 [in Russian].

10. Lisitsky, D. V., Horoshilov, V. S., & Kolesnikov, A. A. (2014). Animated cartography is the essence, characteristics and prospects. *Izvestia Vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *4/C*, 91–97 [in Russian].

11. Lisitsky, D. V., Bugakov, P. Ju., & Nguen, An' Taj. (2016). *Trekhmernaya komp'yuternaya kartografiya [Three-dimensional computer mapping]*. Novosibirsk: SSUGT [in Russian].

12. Berljant, A. M. (2014). *Kartografiya [Cartography]*. Mopscow: KDU [in Russian].

13. Kapralov, E. G., Koshkarev, A. V., & Tikunov, V. S. (2008). *Geoinformatika [Geoinformatics]*. V. S. Tikunov (Ed.). Moscow: Academy [in Russian].

14. Russo Patrizia. (2011). Using Multimedia Cartography to Visualise and Document Stories of Migrating Families. *GEO 511 – Master Thesis (05–921–259)*. Department of Geography – University of Zurich Geographic Information Visualisation and Analysis. Retrieved from http://www.geo.uzh.ch/ fileadmin/files/content/abteilungen/giva/Research/MSc-pdf/msc_thesis_ prusso.pdf.

15. Beata Medyńska-Gulij. (2014). Cartographic sign as a core of multimedia map prepared by non-cartographers in free map services. *Geodeziya i kartografiya [Geodesy and Cartography]*. 63(1), 55-64. doi: 10.2478/geocart–2014–0004.

16. Maiellaro, N., & Varasano, A. (2017). One-Page Multimedia Interactive Map. *ISPRS Int. J. Geo-Inf.*, *6*(2), p. 34.

17. Lauriault Taylor Tracey. (2005). *Cybercartography, Theory and Practice: Issue 5*. Elsevier Science.

18. Lavrent'ev, S. V., & Biktimirova, N. M. (2015). Analysis of displaying extended attributes of urban overland public transportation routes on maps. *Izvestia Vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, 3, 40–46 [in Russian].

19. Medvedev, A. A., Gun'ko, M. S., & Glezer, O. B. (2015) GIS mapping of population distribution for analysis of its spatial dynamics. *Izvestia Vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *6*, 57–61 [in Russian].

20. Zablockij, V. R. (2015). Algorithm for mapping the movement of a point object. *Izvestia Vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *2*, 69–73 [in Russian].

21. Horoshilov, V. S., & Kacko, S. Ju. (2015.) Geo information space and virtual geographic Wednesday. *Izvestia Vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *5/S*, 256–260 [in Russian].

22. Biktimirova, N. M., & Radaman, S. K. (2013). Principles of displaying animated geographical information in television express maps. *Izvestia Vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, 6, 33–40 [in Russian].

23. Cartwright, W., Peterson, M., & Gartner, G. (2006). Future directions for multimedia cartography. In *Multimedia cybercartography*. Berlin: Springer-Verlag.

Received 02.05.2017

AUTOMATED GENERATION OF INFORMATION PRODUCTS ON THE BASIS OF OPEN MONITORING DATA ON AIR POLLUTION

Igor V. Matelenok
Saint-Petersburg State University of Aerospace Instrumentation, 190000, Russia, Saint-Petersburg, 67 Bolshaya Morskaya St., Ph. D, Assistant Professor, phone: (812)494-70-15, e-mail: igor_matelenok@mail.ru

Formats of data representation used for publishing Saint-Petersburg air monitoring data in open-access were considered, and the peculiarities that impede the use of the data were identified. Reporting formats for available public data facilitating visual assessment and automatic analysis of atmospheric pollution conditions were defined. These are the flat tables for storing numeric data and the maps for visualizing spatial variations of pollutant concentrations. An approach to building corresponding data products on the basis of public air monitoring data with programming language R and its ecosystem was proposed. Software for automated generation of the thematic maps and the files in table formats from daily text reports was developed and put into test operation.

Key words: atmosphere, geographic information systems, pollutant concentration, atmospheric air monitoring, map generation, monitoring system, thematic maps.

REFERENCES

1. Rybal'skiy, N. G., Murav'eva, E. V., Boriskin, D. A., Dumnov, A. D., Eremin, E. A., Miroshnichenko, N. A., Nasyrova, V. A., … Yakovlev, A. S. (2016). *Gosudarstvennyy doklad "O sostoyanii i ob okhrane okruzhayushchey sredy Rossiyskoy Federatsii v 2015 godu" [State report "Condition and protection of the environment of the Russian Federation in 2015"]*. Moscow: NIA-Priroda Moskva. Retrieved from http://www.mnr.gov.ru/gosdoklad-eco-2015/ [in Russian].

2. Ogudov, A. S., Kreymer, M. A., & Turbinsky, V. V. (2015). Ecological disaster and emergency planning zones in territory management. *Vestnik SGUGiT [Vestnik SGUGT]*, 1(29), 111–128. Retrieved from http://vestnik.ssga.ru/wp-content/uploads/2016/02/Вестник-СГУГиТ-1-29-2015.pdf [in Russian].

3. Chernogaeva, G. M., Malevanov, Yu. A., & Zhuravleva, L. R. (2015). Environmental pollution monitoring in the Russian Federation: observations arrangements, information synthesis and distribution. *Problems of ecological monitoring and ecosystem modeling [Problemy ekologicheskogo monitoringa i modelirovaniya ekosistem]*, *26*(2), 128–138. Retrieved from https://elibrary.ru/item.asp?id=25139933& [in Russian].

4. Azemov, D. T. (2016). Saint-Petersburg air pollution monitoring system. *Environment of Saint-Petersburg [Okruzhayushchaya sreda Sankt-Peterburga]*, *2*(2), 8–14 [in Russian].

5. *Official website of Administration of St. Petersburg. Committee for Nature Use Environmental Protection and Ecological Safety.* (n. d.). Retrieved from http://gov.spb.ru/gov/otrasl/ecology/ [in Russian].

6. *Ecological Portal of Saint-Petersburg.* (n. d.). Retrieved from http://infoeco.ru

7. *Open Data portal of Saint-Petersburg.* (n. d.). Retrieved from http://data.gov.spb.ru/ [in Russian].

8. *Open Data portal of the Russian Federation.* (n. d.). Retrieved from http://data.gov.ru/

9. Venables, W. N., Smith, D. M., & the R Development Core Team. (2013). *Vvedenie v R. Zametki po R: sreda programmirovaniya dlya analiza dannykh i grafiki. Ver. 2.15.0 [An Introduction to R. Notes on R: A Programming Environment for Data Analysis and Graphics. Version 2.15.0]*. (A. A. Fomenko, Trans.). Moscow [in Russian].

10. Carslaw, D. C., & Ropkins, K. (2012). Openair – An R package for air quality data analysis. *Environmental Modelling & Software*. 27, 52–61. doi: 10.1016/j.envsoft.2011.09.008.

11. Vitolo, C., Russell, A., & Tucker, A. (2016). Rdefra: Interact with the UK AIR Pollution Database from DEFRA. doi: 10.21105/joss.00051.

12. Brantley, H. L., Hagler, G. S. W., Kimbrough, E. S., Williams, R. W., Mukerjee, S., & Neas, L. M. (2014). Mobile air monitoring data-processing strategies and effects on spatial air pollution trends. *Atmospheric Measurement Techniques*, *7*(7), 2169–2183. doi:10.5194/amt-7-2169-2014.

13. Hornik, K. (2012). The comprehensive R archive network. *Wiley Interdisciplinary Reviews: Computational Statistics*, *4*(4), 394–398. doi: 10.1002/wics.1212.

14. Wickham, H. (2016). Httr: Tools for working with URLs and HTTP. R package version 1.1.0. Retrieved from http://CRAN.R-project.org/package=httr.

15. Wickham, H. (2015). xml2: Parse XML. R package version 0.1.2. Retrieved from http://CRAN.R-project.org/package=xml2.

16. Kahle, D., & Wickham, H. (2013). ggmap: Spatial Visualization with ggplot2. *The R Journal*, *5*(1), 144–161. Retrieved from http://journal.r-project.org/archive/2013-1/kahle-wickham.pdf.

17. Map tiles by Stamen Design, under CC BY 3.0. Data by OpenStreetMap, under ODbL [Map]. Retrieved from http://maps.stamen.com/.

18. Brewer, C. A., Harrower, M., Sheesley, B., Woodruff, A., & Heyman, D. (2011). *ColorBrewer 2.0: color advice for cartography.* Retrieved from http://colorbrewer2.org.

19. *Website of Institute for Innovation and Master Degree Basic Training SUAI.* (n. d.). Retrieved from http://fiqm.ru/.

Received 26.05.2017

RESEARCH OF FEATURES OF PERCEPTION OF THE TACTILE SYMBOLS OF THE VARIOUS USER GROUPS TO DEVELOP SPECIAL CARTOGRAPHIC MATERIALS

Yaroslava G. Poshivaylo
Siberian State University of Geosystems and Technologies, 630108, Novosibirsk, 10 Plakhotnogo St., Ph. D., Associate Professor, Department of Cartography and Geoinformatics, phone: (383)361-06-35, e-mail: yaroslava_po@mail.ru

Yuliya N. Andryukhina
Siberian State University of Geosystems and Technologies, 630108, Novosibirsk, 10 Plakhotnogo St., Masters Student of the Department of Cartography and Geoinformatics, phone: (999)466-00-90, e-mail: andryukhina.yuliya@yandex.ru

A large number of people nowadays, because of their physical disability, are obliged to adapt to the surrounding world. In many countries, public support programmes for this category of citizens are poorly developed or do not work. In Russia, the state program «Dostupnaya sreda» for 2011–2020 was adopted. This program is aimed at a circle of citizens with disabilities, in order to increase the degree of accessibility to facilities and services in priority areas of life. One of the objectives of the program is to eliminate social fragmentation between disabled people and citizens who are not related to the disabled category. Under this program, the authors developed a tactile Atlas of Novosibirsk region for people with limitation visual function. Developed a system of tactile symbols for maps in the Atlas. Conducted a study on the perception of tactile symbols of different user groups.

Key words: tactile cartography, limitation of visual function, symbols, relief graphics, tactile perception, assistive tools and technologies.

REFERENCES

1. Medvedev, A. A., Alekseenko, N. A., & Vasyov, M. K. (2016). The tactile atlas of Moscow – complex cartographical atlas of the urban area for visually impared persons. *Geodeziya i kartografiya [Geodesy and Cartography]*, *7*, 8–14 [in Russian].

2. Agilera Delgado, T. P. (2009). Development of tactile cartography abroad. *Geodeziya i kartografiya [Geodesy and Cartography]*, *1*, 28–30 [in Russian].

3. Karpov, A. A. (2013). Assistive information technologies based on audio-visual speech interfaces. *Trudy SPIIRAN [SPIIRAS Proceedings]*, *4*, 114–128 [in Russian].

4. Poshivaylo, Ya. G., Lesnevskii, Yu. Yu., & Andryukhina, Yu. N. (2016). Development of symbols for a series of tactile maps of regions of the Russian Federation. In *Sbornik nauchnykh trudov: Vyp. 9. Geoinformacionnoe obespechenie prostranstvennogo razvitiya Permskogo kraya [Proceedings of Geoinformation Support of the Spatial Development of Perm Krai: Issue 9]* (pp. 90 – 96). Perm: Perm State University [in Russian].

5. Poshivaylo, Ya. G., & Andryukhina, Yu. N. (2017). Research features of perception of tactile symbols by pupils with limitation visual function. In *Sbornik materialov Interekspo GEO-Sibir'-2017: Mezhdunarodnoy nauchnoy konferentsii: T. 2. Geodeziya, geoinformatika, kartografiya, marksheyderiya [Proceedings of Interexpo GEO-Siberia-2017: International Scientific Conference: Vol. 2. Geodesy, Geoinformatics, Cartography, Mine Surveying]* (pp. 78–83). Novosibirsk: SSUGT [in Russian].

6. Poshivailo, Y. G., Dmitriev, D. V., & Lesnevsky, Y. Y. (2014). Current status and development prospects of tactile cartography. In *Sbornik materialov Mezhdunarodnoy konferentsii "InterKarto/InterGIS": № 20 [Proceedings of the International Conference "InterCarto/InterGIS", 20*, 467–470. doi: 10.24057/2414-9179-2014-1-20-467-470 [in Russian].

7. Nabokova, L. A. (2009). Modern Assistive Technologies for Persons with Motor Disorders. *Defektologiya [Defectology]*, *4*, 73–80 [in Russian].

8. Sokolov, V. V. (2009). Evolution of Information Technologies for Persons with Visual Disorders. *Defektologiya [Defectology]*, *5*, 57–63 [in Russian].

9. Dyshlyuk, S. S., Nikolaeva, O. N., & Romashova, L. A. (2015). To the question of formalization of the process of creating thematic maps in GIS environment. *Vestnik SGUGiT [Vestnik SSUGT]*, *2*(30), 78–85 [in Russian].

10. Bruce B. Blasch, William R. Wiener, & Richard L. (1997). Foundations of orientation and mobility (pp. 284–316). New-York.

11. Litvak, A. G. (1998). *Psihologiya slepyh i slabovidyashchih [Psychology of the blind and visually impaired]*. St. Petersburg: Herzen State Pedagogical University of Russia Publ. [in Russian].

12. Ermakov, V. P. (1988). *Graficheskie sredstva naglyadnosti dlya slabovidyashchih [Graphical visual aids for the visually impaired]*. Moskow: VOS [in Russian].

13. Novikov, A. K. (2010). Psychological features of the perception of the blind. *Molodoj uchenyj [Young scientist]*, *11*, 82–86 [in Russian].

14. Igumnov, A. Yu. (2015). Features of tactile perception of relief graphics in people with limited vision. In *Materialy 53-j Mezhdunarodnoj nauchnoj studencheskoj konferencii "Psihologiya" [Proceedings of the 53rd International Scientific Student Conference "Psychology"]* (pp. 89–90). Novosibirsk: Novosibirsk State University [in Russian].

15. *Informacionnaya sistema [Information system]*. (n. d.). Retrieved from http://brailleauthority.org/tg/web-manual/.

Received 27.04.2017

GIS-BASED INVENTORY OF URBAN GREEN SPACES

Lyudmila K. Trubina
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10, Plakhotnogo St., Dr. Sc., Professor, Department of Ecology and Land Management, phone: (383)361-09-11, e-mail: lab.ite@ssga.ru

Olga N. Nikolaeva
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10, Plakhotnogo St., Dr. Sc., Associate Professor, Department of Ecology and Environmental Management, phone: (383)361-06-86, e-mail: onixx76@mail.ru

Polina I. Mullayarova
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10, Plakhotnogo St., Ph. D. Student, Department of Ecology and Environmental Management, phone: (383)361-06-86, e-mail: lina181991@mail.ru

Yevgenia I. Baranova
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10, Plakhotnogo St., Ph. D., Associate Professor, Department of Ecology and Environmental Management, phone: (383)361-06-86, e-mail: e-mail: evg.dxn@yandex.ru

The article describes a case-study of GIS-based inventory of urban greenery of nursery school in Novosibirsk city. A brief characteristic of urban greenery's environmental role and cases of planning and organization of urban gardening in countries of the EEC are given. The tasks of environmental effective planning of urban gardening are stated. The problems caused by low-level of computerization of planning and organization of urban landscaping in Russia are listed. To solve the problems the development of geoinformation model of urban greenery is proposed. The technique of geoinformation modeling of urban greenery of nursery school in Novosibirsk city is detailed. The digital greening scheme visualizing the spatial and quality of plantations is presented. The structure of data base is described. The criteria of qualitative assessment of plantations are stated. An act of assessing the quality of plantations in the kindergarten is presented. The conclusions on perspectives of GIS-modelling in sphere of urban greenery planning are made.

Key words: vegetative community, urbanized territories, urban gardening, ecosystems of urbanized areas, greening scheme, geoinformation mapping.

REFERENCES

1. Trubina, L. K. (2012). Methodological aspects of urban lands state ecological assessment]. In *Sbornik materialov Interekspo GEO-Sibir'-2012: Mezhdunarodnoy nauchnoy konferentsii: T. 2. Distancionnye metoda zondirovaniya Zemli i foto-grammetriya, monitoring okruzhayushchej sredy, geoehkologiya [Proceedings of Interexpo GEO-Siberia-2012: International Scientific Conference: Vol. 2. Remote Sensing Methods of the Earth and Photogrammetry, Environmental Monitoring, Geoecology]* (pp. 200–203). Novosibirsk: SSUGT [in Russian].

2. Kulakova, S. A. (2014). Accounting the green plantations of the city of Perm. *Izvestiya Samarskogo nauchnogo centra RAN [Samara Scientific Center of the Russian Academy of Sciences], 1–3*, 769–771 [in Russian].

3. Kulakova, S. A. (2012). Ocenka sostoyaniya zelenyh nasazhdenij goroda [Assessment of the state of green plantations of the city]. *Geograficheskij vestnik [Geographical Bulletin], 4*, 59–66 [in Russian].

4. Menke, Peter (2013). *Stiftung «Die grüne Stadt»*. Berlin: 40 Seiten [in German].

5. Berliner Unternehmen fördern Biologische Vielfalt. (n. d.). In *Vorschläge zum Handeln*. Retrieved from http://www.stadtentwicklung.berlin.de/natur_gruen/naturschutz/downloads/publikationen/Leitfaden_BiologischeVielfalt_BerlinUnternehmen.pdf [in German].

6. Freiburg Green City – Wege zur Nachhaltigkeit. (n. d.). Retrieved from http://www.freiburg. de/pb/site/Freiburg/get/params_E975341429/640887/GC-Broschüre_D-2014.pdf [in German].

7. Gartenschauen nachhaltig gestalten. (n. d.). In *Stiftung «Die grüne Stadt»*. Retrieved from http://www.die-gruene-stadt.de/gartenschauen-nachhaltig-gestalten.pdfx [in German].

8. Shajhutdinova, A. A., Markova, O. S. (2016). Ecological aspects of the planning structure of the city of Orenburg. *Izvestiya OGAU [Proceedings of the Orenburg State Agrarian University], 4*, 186–189 [in Russian].

9. Shajhutdinova, A. A., & Ivleva, Ya. S. (2016). Urban green plantations as an element of the ecological framework system. *Uchenye zapiski Petrozavodskogo gosudarstvennogo*

universiteta. Obshchestvennye i gumanitarnye nauki [Scientific notes of Petrozavodsk State University. Social and Human Sciences], *8*, 91–96 [in Russian].

10. Bäume und Pflanzen lassen Städte atmen Schwerpunkt – Feinstaub. (n. d.). In *Stiftung «Die grüne Stadt»*. Retrieved from http://www.helix-pflanzensysteme.de/media/block_downloads /281/end_bro_feinstaub_2008-05-14.pdf [in German].

11. Urbanes Grün Für ein besseres Leben in Städten. (n. d.). In *Stiftung «Die grüne Stadt»*. Retrieved from http://www.die-gruene-stadt.de [in German].

12. Trubina, L. K., Baranova, E. I., & Chagina, G. S. (2013). GIS mapping and greenery inventory. In *Sbornik materialov Interekspo GEO-Sibir'-2013: Mezhdunarodnoy nauchnoy konferentsii: T. 4. Distancionnye metody zondirovaniya Zemli i foto-grammetriya, monitoring okruzhayushchej sredy, geoehkologiya [Proceedings of Interexpo GEO-Siberia-2013: International Scientific Conference: Vol. 4. Remote Sensing Methods of the Earth and Photogrammetry, Environmental Monitoring, Geoecology]* (pp. 82–86). Novosibirsk: SSUGT [in Russian].

13. Morozova, G. Yu., Gluhov, V. A., & Baburin, A. A. (2011). Geoinformation system "Green plantations of the city of Khabarovsk". *Izvestiya Samarskogo nauchnogo centra RAN [Samara Scientific Center of the Russian Academy of Sciences]*, *1-6*, 1367–1370 [in Russian].

14. Urban Development Code of the Russian Federation (text with amendments and additions for 2012). (2012). Moscow: Current legislation [in Russian].

15. Decision of the Council of Deputies of the City of Novosibirsk on February 22, 2012 No. 539. *On the Rules for the Creation, Protection and Maintenance of Greenery in the City of Novosibirsk*. Retrieved from http://gorsovetnsk.ru/sessions/view/solution/3752 [in Russian].

16. *GOST 28329-89. Ozelenenie gorodov. Terminy i opredeleniya [GOST 28329-89. Landscaping of cities. Terms and Definitions]*. Retrieved from http://snipov.net/c_4746_snip_ 106499.html [in Russian].

17. Baranova, E. I., & Lugovskaya, A. Yu. (2015). Use of the method of the computer analysis of digital images in bioindicator researches. In *Sbornik materialov Interekspo GEO-Sibir'-2015: Mezhdunarodnoy nauchnoy konferentsii: T. 4. Distancionnye metody zondirovaniya Zemli i foto-grammetriya, monitoring okruzhayushchej sredy, geoehkologiya [Proceedings of Interexpo GEO-Siberia-2015: International Scientific Conference: Vol. 4. Remote Sensing Methods of the Earth and Photogrammetry, Environmental Monitoring, Geoecology]* (pp. 236–239). Novosibirsk: SSUGT [in Russian].

18. Trubina, L. K., Hramova, E. P., & Lugovskaya, A. Yu. (2016). Computer analysis of lamina images of potentilla fruticosa for bioindication of urbanized territories. *Vestnik SGUGiT [Vestnik SSUGT]*, *4*(36), 263–273 [in Russian].

19. Mirtova, I. A., & Telyatnikov, V. M. (2013). Estimation of dynamics of green plantations of Moscow on space images. *Izvestiya vuzov. Geodeziya i aehrofotos"emka [Izvestiya vuzov. Geodesy and Aerophotography]*, *2*, 75–80 [in Russian].

20. Mullayarova, P. I. (2017). On the need to improve the methodology of inventory of urban green spaces. In *Sbornik materialov Interekspo GEO-Sibir'-2017: Mezhdunarodnoy nauchnoy konferentsii: T. 2. Distancionnye metody zondirovaniya Zemli i foto-grammetriya, monitoring okruzhayushchej sredy, geoehkologiya [Proceedings of Interexpo GEO-Siberia-2017: International Scientific Conference: Vol. 2. Remote Sensing Methods of the Earth and Photogrammetry, Environmental Monitoring, Geoecology]* (pp. 180–185). Novosibirsk: SSUGT [in Russian].

21. Trubina, L. K., Mullayarova, P. I., Baranova, E. I., & Nikolaeva, O. N. (2014). Some approaches to geoinformation mapping green plants. In *Sbornik materialov Interekspo GEO-Sibir'-2014: Mezhdunarodnoy nauchnoy konferentsii: T. 4. Distancionnye metody zondirovaniya Zemli i foto-grammetriya, monitoring okruzhayushchej sredy, geoehkologiya [Proceedings of Interexpo GEO-Siberia-2014: International Scientific Conference: Vol. 4. Remote Sensing Methods of the Earth and Photogrammetry, Environmental Monitoring, Geoecology]* (pp. 68–73). Novosibirsk: SSUGT [in Russian].

Received 19.06.2017

GIS MAPPING OF ANTHROPOGENIC IMPACT ON THE ENVIRONMENT BY THE EXTRACTION OF PLACER GOLD (FOR EXAMPLE, ERAVNINSKY DISTRICT OF THE REPUBLIC OF BURYATIA)

Marina V. Tsydypova
Buryat State University, 670000, Russia, the Republic of Buryatia, Ulan-Ude, 24a Smolina St., Ph. D., Senior Lecture, Department of Land Use and Land Cadastre, e-mail: ecovie@mail.ru

Andrei G. Suprunenko
Buryat State University, 670000, Russia, the Republic of Buryatia, Ulan-Ude, 24a Smolina St., Magister of the Department of Land Use and Land Cadastre, e-mail: suprunenko03@mail.ru

The article deals with the methodology of geoinformation mapping and analysis of the impact of gold mining enterprises on natural landscapes based on Landsat satellite images and GIS technologies on the example of the Eravninsky district of the Republic of Buryatia. The article presents brief information on the extraction of alluvial gold in Buryatia and the history of development of the Eravninsky gold-sands district. As a result of the study, the mapping of terrain areas subject to anthropogenic impacts was carried out and the enterprises that are exploring and mining alluvial gold were identified, their license plots were mapped within the test plot, mapping of disturbed river valleys was carried out, the degree of disturbance of natural landscapes and the area of formed dumps was assessed.

Key words: satellite images Landsat, GIS technology, Eravninskiy district, the Republic of Buryatia, mining of placer gold, anthropogenic impact of enterprises.

REFERENCES

1. Gold production in Russia. (n. d.). Retrieved from at https://zolotodb.ru/articles/other/gold/10922 [in Russian].
2. Kirsanova, N. I. (2010) Placer gold of Buryatia. *GLOBUS [GLOBUS]*, *5*(13), 38–40 [in Russian].
3. Placer gold of Buryatia. (n. d.). Retrieved from http://vnedra.ru/россыпное-золото-бурятии-311/ [in Russian].
4. About the results of activities of the Ministry of Natural Resources of the Republic of Buryatia for 2015 and tasks for 2016. (n. d.). Retrieved from at http://minpriroda-rb.ru/Pressa/index.php?SECTION_ID = 1128&ELEMENT_ID=45683 [in Russian].
5. Imetenov, A. B, & Khartikov, L. N. (2013). Analysis of the impact of gold mining enterprises on the environment (by the example of the Irokind mine and Buryatzoloto OJSC). *Vestnik VSGUTU [ESSUTM Bulletin]*, *2*(41), 178–182 [in Russian].
6. Egidarev, E. G., & Simonov, E. A. (2014). Assessment of the environmental consequences of placer gold mining in the basin of the river. Amur. *Geoekologiya. Inzhenernaya geologiya. Gidrogeologiya. Geokriologiya [Geoecology. Engineering Geology. Hydrogeology. Geocryology]*, *5*, 429–441 [in Russian].
7. *Zolotye reki. Vyp. 1. Amurskiy basseyn [Golden rivers: Issue 1. The Amur basin]*. (2012). E. A. Simonov (Ed.). Vladivostok: Wildlife Fund (WWF) [in Russian].
8. Simonov, E. A., Egidarev, E. G., Kalashnikov, U. A., Umin, G, & Gandbold, D. (2012). The scale of the environmental consequences of placer gold mining in the river basin Amur. In *Materialy VII Mezhdunarodnoi nauchno-prakticheskoi konferentsii: Reki Sibiri i Dal'nego Vostoka [Proceedings of the 7th International Scientific and Practical Conference: Rivers of Siberia and of the Far East]* (pp. 46–49). Blagoveshchensk [in Russian].
9. Egidarev, E. G., & Simonov, E. A. (2013). Use of remote sensing data for mapping the consequences of gold mining and assessing the basin of disturbed watercourses. In *Materialy Mezhdunarodnoi konferentsii*: *Distantsionnoe zondirovanie okruzhayushchey sredy: nauchnye i*

prikladnye issledovaniya v Aziatsko-Tikhookeanskom regione (RSAP 2013) [Proceedings of the International Conference: Remote Sensing of the Environment: Applied Research in the Asia-Pacific Region (RSAP 2013)] (pp. 62–63). Vladivostok [in Russian].

10. Egidarev, E. G., & Simonov, E. A. (2014) Assessment of the environmental consequences of placer gold mining in the basin of the river. Amur. *Geoekologiya. Inzhenernaya geologiya. Gidrogeologiya. Geokriologiya [Geoecology. Engineering Geology. Hydrogeology. Geocryology]*, *5*, 429–441 [in Russian].

11. Asner, G. P, Llaktayo, W., Tupaachi, R., & Luna, E. R. (2013). High rates of gold production in the Amazon were identified through high-resolution monitoring. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(46), 18454–18459. doi: 10.1073/pas.1318271110.

12. Lobo, F. L., Costa, Michigan, Novo, E. M., & Telmer, K. (2016). Distribution of artisanal and small-scale gold mining in the basin of the river. Tapajos (the Brazilian Amazon) for the past 40 years and the relationship with the silting of water. *Remote sens.*, *8*, 579 p.

13. Beshentsev, A. N. (2011). Cartographic monitoring of nature use. *Geodezija i kartografija [Geodesy and Cartography]*, *3*, 14–18 [in Russian].

14. Yalovik G. A. (2010). State and Prospects for the Development of the Mineral and Raw Materials Base of Buryatia. In *Sbornik materialov Vserossiyskoy nauchno-prakticheskoy konferentsii: Novye i netraditsionnye tipy mestorozhdeniy poleznykh iskopaemykh Pribaykal'ya i Zabaykal'ya [Proceedings of the All-Russian Scientific and Practical Conference: New and Unconventional Types of Mineral Deposits in Baikal and Transbaikalia]* (pp. 3–15). Ulan-Ude: ECOS [in Russian].

15. Petrash, A. G., Bakhtin, V. I., Plyasova, S. L., & Kirsanova, N. I. (2007). Alluvial gold and gold of the weathering crust of the Eravninskaya Depression. *Razvedka i okhrana nedr [Exploration and Conservation of Mineral Resources]*, *12*, 73–78 [in Russian].

16. Fedotova, I. V. (2014) The main ecological problems of alluvial gold mining on the example of the Republic of Khakassia. In *Materialy XVIII Mezhdunarodnogp simp. im. akad. M. A. Usova studentov i molodykh uchenykh, posvyashch. 115-letiyu so dnya rozhdeniya akad. Akad. nauk SSSR, prof. K. I. Satpaeva, 120-letiyu so dnya rozhdeniya chl.-kor. Akad. nauk SSSR, prof. F. N. Shakhova*: *T. 1. Problemy geologii i osvoeniya nedr [Proceedings of the 18th International Symposium Named Acad. M. A Usov of Students and Young Scientists Dedicated to the 115th Anniversary of the Academician of the USSR Academy of Sciences, Prof. K. I. Satpayev, to the 120th Anniversary of the Corresponding Member of the USSR Academy of Sciences, prof. F. N. Shakhov: Vol. 1. Problems of Geology and Development of the Earth]* (pp. 766–768). Tomsk [in Russian].

Received 25.05.2017

TERRITORIAL ORGANIZATION OF TOURISM AND RECREATION ACTIVITIES AT THE REGIONAL LEVEL: THEORETICAL AND PRACTICAL ASPECTS

Lyudmila B.-Zh. Maksanova
Baikal Institute of Nature Management SB RAS, 670047, Russia, Ulan-Ude, 6 Sakhyanovoy St., Ph. D., Senior Researcher, Associate Professor, e-mail: lmaksanova@yandex.ru

Erdeni D. Sanzheev
Baikal Institute of Nature Management SB RAS, 670047, Russia, Ulan-Ude, 6 Sakhyanovoy St., Ph. D., Senior Researcher, e-mail: esan@binm.ru

Darima G. Budaeva
Baikal Institute of Nature Management SB RAS, 670047, Russia, Ulan-Ude, 6 Sakhyanovoy St., Ph. D., Lead Engineer, e-mail: budaevadarima@yandex.ru

The paper deals with theoretical approaches and practical aspects of tourism and recreation territorial organization. It provides analysis of the conceptual framework for designating territories on which tourism and recreation-related activities are carried out. It has been revealed that specialist literature and legislative practices demonstrate terminology confusion, which is transferred into practical usage. The paper suggests using «a zone of recreational development» as a term and provides a definition for it. The central ecological zone of the Lake Baikal natural territory (CEZ of BNT) located in the Republic of Buryatia, Russia is comprised of nine forms of tourism and recreation territorial organization. There has been developed a map showing the current state of tourism and recreation territorial organization within the CEZ of BNT. The paper also gives assessment of the current state of the recreational development zones within the CEZ of BNT (the Republic of Buryatia, Russia) and presents the calculations done in order to determine the projected numbers of holidaymakers in the recreational development zones.

Key words: tourism, tourism and recreation-related activities, territorial organization, Central ecological zone, Baikal natural territory, a zone of recreational development.

REFERENCES

1. Kruzhalin, V. I., Kruzhalin, K. V., & Shabalina, N. V. (2016). Current state, problems and prospects of the Russian tourism. *Vestnik Natsional'noy akademii turizma [Vestnik of National Tourism Academy]*, *1*(37), 10–13 [in Russian].
2. The project of the Federal Law «On amendments being made to the Federal Law «On natural curative resources, health and recreation areas and resorts» with the aim to develop the resort infrastructure». Retrived from http://mkrf.ru/ministerstvo/departament/detail.php?ID=1009348& SECTION_ID =19775 & sphrase_id=6428421 [in Russian].
3. Preobrazhenskiy, V. S. (Ed.). (1975). *Teoreticheskie osnovy rekreatsionnoy geografii [Theoretical foundations of recreational geography]*. Moscow: Nauka [in Russian].
4. Mironenko, N. S., & Tverdokhlebov, I. T. (1981). *Rekreacionnaja geografija [Recreational geography]*. Moscow: Moscow University Publ. [in Russian].
5. Mazhar, L. Yu. (2008). Spati-temporal organization of tourist-recreational activity. *Vestnik Baltiyskogo federal'nogo universitetata im. I. Kanta. Seriya: Estestvennye i meditsinskie nauki [The Vestnik of the Immanuel Kant Baltic Federal University. Natural and Medical Sciences]*, *1*, 100–104 [in Russian].

6. Kruzhalin, V. I., Mironenko, N. S., Zigern-Korn, N. V., & Shabalina, N. V. (2014). *Geografiya turizma [Tourism geography]*. Moscow: Federal Agency for tourism [in Russian].

7. Alexandrova, A. Yu. (2009). Structural-functional analysis of the world touristic space. *Vestnik Moskovskogo Universiteta. Ser. Geografia [Moscow University Herald. Geography]*, *4*, 21–26 [in Russian].

8. Dunets, A. N. (2009). *Territorial'naya organizatsiya gornykh turistsko-rekreatsionnykh sistem (na primere Altae-Sayanskogo regiona) [The territorial organization of mountain tourist-recreational systems (on an example of Altay-Sayan region)]*. Barnaul: AltGTU Publ. [in Russian].

9. Alaev, E. B. (1983). *Sotsial'no-ekonomicheskaya geografiya. Ponyatiyno-terminologicheskiy slovar' [Social and economic geography. Conceptually-terminological dictionary*]. Moscow: Mysl' [in Russian].

10. Tkachenko, A. A. (1995). *Territorial'naya obshchnost' v regional'nom razvitii i upravlenii [Territorial community in the regional development and management]*. Tver: Tver State University Publ. [in Russian].

11. Shvets, I. Yu., Czyz-Gwiazda, Ewa, & Demczuk, Marek. (2014). Development of the cluster form of spatial organization for the territory in tourism. *Vestnik assotsiatsii VUZov turizma i servisa [Universities for Tourism and Service Association Bulletin]*, *8*(4), 33–41 [in Russian].

12. Ashugatoian, S. G. (2016). Evolution of views on the tourism spatial organization. *Vestnik Udmurtskogo Universiteta. Ser. Biologiya. Nauki o Zemle [The Bulletin of Udmurt University. Biology. Earth Sciences]*, *26*(3), 127–134 [in Russian].

13. Mekush, G. E., & Ushakova, E. O. (2015). Analysis of Novosibirsk region resource potential for tourist industry development. *Vestnik SGUGiT [Vestnik SSUGT]*, *1*(29), 101–110 [in Russian].

14. Khromov, Yu. B., & Klyushin, V. A. (1976). *Organizatsiya zon otdykha i turizma na poberezh'e Baykala [Organization of recreation areas and tourism on the Lake Baikal coast]*. Moscow: Stroyizdat [in Russian].

15. Federal Law of December 29, 2004 No. 190-FZ (ed. July 3, 2016). Urban Development Code of the Russian Federation. Retrived from http://www.consultant.ru/document/cons_doc_LAW_51040/ [in Russian].

16. Ryashchenko, S. V., Bogdanov, V. N., & Romanova, O. I. (2008). *Regional'nyy analiz rekreatsionnoy deyatel'nosti [Regional analysis of recreational activity]*. Irkutsk: V. B. Sochava Institute of Geography SB RAS Publ. [in Russian].

17. Evstropyeva, O. V. (2009). *Transgranichnyy turizm v sopredel'nykh regionakh Rossii i Mongolii [Trans-boundary tourism in neighboring regions of Russia and Mongolia]*. Irkutsk: V. B. Sochava Institute of Geography SB RAS Publ. [in Russian].

18. Plyusnin, V. M., & Vladimirov, I. N. (2013). *Territorial'noe planirovanie Tsentral'noy ekologicheskoy zony Baykal'skoy prirodnoy territorii [Territopial planning for the Central ecological zone of the Baikal natural area]*. Novosibirsk: Academic publ. "Geo" [in Russian].

19. Kuskov, A. S., Golubeva, V. L., & Odintsova, T. N. (2005). *Rekreacionnaja geografija [Recreational Geography]*. Moscow: MPSI, Flinta [in Russian].

20. Decree of the Government of the Russian Federation No. 643 of August 30, 2001 (ed. Mach 2, 2015, No. 186). On the approval of the List of activities prohibited in the Central Ecological Zone of the Baikal Natural Area]. Retrived from http://docs.cntd.ru/document/901795935.

21. Gurieva, L. K., & Sozieva, Z. I. (2009). Tourist Clusters of region: problems and prospects of creation. *Regional'naya ekonomika: teoriya i praktika [Regional economics: theory and practice*], *22*(115), 72–80 [in Russian].

22. Pakhakhinova, Z. Z., Batotsyrenov, E. A., & Beshentsev, A. N. (2016). The cartographic registration of the basic spatial objects for monitoring of nature management. *Vestnik SGUGiT [Vestnik SSUGT]*, *2*(34), 94–104 [in Russian].

23. *Problemy razvitiya proizvoditel'nykh sil v basseyne ozera Baykal s uchetom ekologicheskikh trebovaniy (materialy general'noy kontseptsii) [Problems of the productive forces development in the Lake Baikal basin, taking into account environmental requirements (materials of the general concept)]*. (1988). Moscow: SOPS pri Gosplane SSSR [in Russian].

24. *Analiticheskiy obzor ekologicheskikh i sotsial'nykh usloviy obespecheniya ustoychivogo razvitiya territorii Tsentral'noy ekologicheskoy zony Baykal'skoy prirodnoy territorii, napravleniya resheniya ekologo-ekonomicheskikh problem i konfliktov prirodopol'zovaniya (promezhutochnyy otchet) [Analytical review of ecological and social conditions for ensuring sustainable development of the Central Ecological Zone territory of the Baikal Natural Area, directions for solution of ecological and economic problems and environmental management conflicts]*. (2016). Interim report № GR216081720124. Irkutsk: V. B. Sochava Institute of Geography SB RAS [in Russian].

25. Gosudarstvennyy doklad *«O sostoyanii ozera Baykal i merakh po ego okhrane v 2015 godu» [State report "About of the Lake Baikal status and measures to protect it in 2015"]*. (2016). Irkutsk: ANO "KC Expert" [in Russian].

26. *Opredelenie vnutrennego turistskogo potoka v Respublike Buryatiya i velichiny potrebitel'skikh raskhodov turistov na territorii Respubliki Buryatiya [Definition of the internal tourist flow in the Republic of Buryatia and the magnitude of consumer spending of tourists on the territory of the Republic of Buryatia]* (2011). Final Report № 01201164724. Ulan-Ude: Baikal Institute of Nature Management SB RAS [in Russian].

27. Maksanova, L. B.-Zh. (2017) Regulatory framework for the regulation of tourism development in the Lake Baikal basin: ecological aspect. *Turizm: pravo i ekonomika [Tourism: law and economy]*, *1*, 3–8 [in Russian].

28. Mikheeva, A. S., Maksanova, L. B.-Zh., Abidueva, T. I., & Bardakhanova, T. B. (2016). Ecological-economic problems and conflicts in nature management in the Central ecological zone of the Baikal natural territory (Republic of Buryatia). *Geografiya i prirodnye resursy [Geography and Natural Resources]*, *5*, 210–217 [in Russian].

Received 15.06.2017

ABOUT MARKET (CADASTRAL) COST OF LAND PARCEL IMPROVEMENTS

Alexander D. Vlasov
Siberian Scientific Center «Ecoprognoz», 630501, Russia, Novosibirsk region, Krasnoobsk, the house 15, office 3, Ph. D., Scientific Director, phone: (383)348-05-92, e-mail: vlasovad@yandex.ru

Valeriy B. Zharnikov
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Professor, Department of Cadastre and Territorial Planning, phone: (383)361-05-66, e-mail: vestnik@ssga.ru

The article discusses the content of market (cadastral) cost of a single real estate object in correlation with its partial costs: the cost of the land parcel itself and the value of its improvements. The problematical character of the situation is in the fact that often improvements, and they are in the first turn capital construction objects (CCO) together with their functioning maintaining infrastructure, are assigned the properties of the land parcel, mainly determined by its location. In the result CCO cost is often too high and land parcel cost is too low. For that matter defining is the statement, that market (cadastral) cost of land parcel improvements must not exceed the cost of their reproduction (substitution). The article is devoted to the proof of this statement.

Key words: single real estate object, land parcel, improvements, capital construction objects, market (cadastral) valuation, reproduction (substitution) cost, price forming factor, social and economic potential.

REFERENCES

1. Bogolyubov, S. A., & Zolotova, O. A. (2016). *Zemel'noe zakonodatel'stvo [Land legislation]* (2nd ed.). Moscow: Prospekt. Retrived from www.prospekt.org [in Russian].
2. Federal Law of July 13, 2015 No. 218–FZ. *On state registration of real estate*. Retrieved from ConsultantPlus online database [in Russian].
3. Shein, L. B. (2007). *Zemel'noe pravo Rossii [Land Law of Russia]*. Moscow: Eksmo [in Russian].
4. Ustavich, G. A., Poshivaylo, Y. V., Dubrovsky, A. V., Akhmetov, B. Zh., & Poshivaylo, A. O. (2016). Zoning and delimitation lands, adjacent to nuclear test sites, for purposes of commercial using (for example Semipalatinsk test site territory). *Vestnik SGUGiT [Vestnik SSUGT]*, *4*(36), 145–160 [in Russian].
5. Dudinova, O. S. (2016). The main approaches of conducting the registration system on the example of "a unified real estate complex". *Vestnik SGUGiT [Vestnik SSUGT]*, *22*(2), 193–200 [in Russian].
6. Lebedeva, T. A., Gagarin, A. I., Kopylova, Yu. Yu., Moskvin, V. N. (2016). Improved monitoring and estimation of forest land. *Vestnik SGUGiT [Vestnik SSUGT]*, *4*(36), 191–299 [in Russian].
7. Parkhomenko, I. V. (2014). Improvement of information exchange for municipal unit taxable basis formation. *Vestnik SGGA[Vestnik SSGA]*, *3*(27), 137–145 [in Russian].
8. Gryaznova, A. G., & Fedotova, M. A. (Eds.). (2008). *Otsenka nedvizhimosti [Evaluation of real estate]*. Moscow: Finance and Statistics [in Russian].
9. Federal Law of July 29, 1998 No. 135–FZ. *On appraisal activity in the Russian Federation*. Retrieved from ConsultantPlus online database [in Russian].
10. Order of the Ministry of Economic Development of May 20, 2015 No. 297. *The Federal Standard for Evaluation "General concepts of assessment, approaches and requirements for the assessment" (FSO No. 1)*. Retrieved from ConsultantPlus online database [in Russian].
11. Order of the Ministry of Economic Development of May 20, 2015 No. 298. *The Federal Standard for Evaluation "The purpose of valuation and types of value" (FSO No. 2)"*. Retrieved from ConsultantPlus online database [in Russian].
12. Order of the Ministry of Economic Development of May 20, 2015 No. 299. *Federal Standard of Assessment No. 3 "Requirements to the Evaluation Report (FSO No. 3)"*. Retrieved from ConsultantPlus online database [in Russian].
13. Order of the Ministry of Economic Development of October 22, 2010 No. 508. *Federal Valuation Standard No. 4 "Determination of cadastral value (FSO No. 4)"*. Retrieved from ConsultantPlus online database [in Russian].
14. Order of the Ministry of Economic Development of September 25, 2014 No. 611. *Federal Valuation Standard No. 7 "Real Estate Valuation (FSO No. 7)"*. Retrieved from ConsultantPlus online database [in Russian].
15. Order of the Ministry of Property Relations of the Russian Federation of March 6, 2002 No. 568-r. *Methodical recommendations for determining the market value of land plots"*. Retrieved from ConsultantPlus online database [in Russian].
16. Order of the Ministry of Economic Development of May 12, 2017 No. 226. *Methodical instructions on state cadastral valuation*. Retrieved from ConsultantPlus online database [in Russian].
17. Leifer, L. A., & Krainikova, T. V. (2016). Practical application of the modified method the allocation for appraisal of stead and objects of capital construction. *Imushchestvennye otnosheniya v Rossiyskoy Federatsii [Property Relations in the Russian Federation]*, *3*(174), 31–48 [in Russian].
18. *Moskvin, V. N., & Sokolova, T. A.* (2015). Judicial cadastral revaluation of land unit: problems and prospects. *Vestnik SGUGiT [Vestnik SSUGT]*, *1*(29), 82–89 [in Russian].
19. Il'in, M. O. (2016). The appraisal of capital construction objects (real estate objects excluding land value) within assessed value contesting. *Imushchestvennye otnosheniya v Rossiyskoy Federatsii [Property Relations in the Russian Federation]*, *6*(177), 85–93 [in Russian].

20. *Metodicheskie rekomendatsii po opredeleniyu rynochnoy stoimosti zemel'nykh uchastkov po kadastrovym kvartalam goroda Novosibirska [Methodical recommendations for determining the market value of land plots in the cadastral blocks of the city of Novosibirsk]*. (2007). (4th ed.). Novosibirsk: Siberian Branch of Russian Academy of the Agricultural Sciences. Retrived from: http://www.cal.su/show_art.php?id=5 [in Russian].

21. Gordeyev, A. V. (2016). Peculiarities of cadastral assessments of lands occupied by industrial objects and their technogenic pollution. *Vestnik SGUGiT [Vestnik SSUGT]*, *4*(36), 225–234 [in Russian].

22. Varlamov, A. A. (2014). *Sistema gosudarstvennogo i munitsipal'nogo upravleniya [System of state and municipal management]*. Moscow: GUZ [in Russian].

23. Karpik, A. P., Osipov, A. G., & Murzintsev, P. P. (2010). *Upravlenie territoriey v geoinformatsionnom diskurse [Territory management in geoinformation discourse]*. Novosibirsk: SGGA [in Russian].

24. Mazur, I. I., Shapiro, V. D., & Ol'derroge, N. G. (2004). *Development [Development]*. Moscow: Economic, 2004 [in Russian].

25. *Data base of state cadastral valuation* (n. d.). Retrived from: https://rosreestr.ru/wps/portal/cc_ib_svedFDGKO.

26. Vlasov, A. D., Pon'ko, V. A. (1996). Measurement of astrogeophysical space. Questions of modeling of geocosmic links. *Trudy nauchnogo tsentra "Ekoprognoz": Vyp. 1 [Proceedings of the scientific center "Ecoprognoz": Issue 1]*. Novosibirsk: Siberian Branch of Russian Academy of the Agricultural Sciences. Retrived from: http://www.cal.su/show_art.php?id=14 [in Russian].

27. Vlasov, A. D., & Zharnikov, V. B. (2016). The definition of norms of land parcels rational use on the basis of modelling their economic potential. *Vestnik SGUGiT [Vestnik SSUGT]*, *3*(35), 111–127 [in Russian].

28. Vlasov, A. D. (n. d.). *The practice of applying the theory of real estate valuation in Russia*. Retrived from http://www.cal.su/show_art.php?id=103 [in Russian].

29. *The public cadastral map of Rosregister*. (n. d.). Retrived from www.maps.rosreestr.ru [in Russian].

Received 05.07.2017

TECHNOLOGICAL PROCESS OF IMPROVING DATA QUALITY METHOD IN UNIFIED STATE REAL ESTATE REGISTER

Mikhail P. Dorosh
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D. Student, Department of Cadastre and Territorial Planning, phone: (383)266-00-39, e-mail: doroshmp@mail.ru

Improving data quality in Unified State Real Estate Register (USRER) is one of the most important tasks, as unreliable and incomplete register can not be an effective instrument of right holder rights protection and taxation. The data quality improving actions had officially been completed before the Federal Law № 218-ФЗ from 13.07.2015 «About the Unified State Real Estate register» became law. However, according to the statistic information, this work is still far from its finish. The existing methods of data quality improving of the Unified State. Register of Real Estate Rights and Transactions (USR of RERT) and State Real Estate Cadastre do not contain a number of legal, organizational and technical solutions enabling to most effectively eliminate existing errors, and also providing information about the works being performed by state registrators in order for them to take correct and weighed decisions. The suggested method provides organizational control for spreading and correcting errors in USRER and creating information

model which contains information about current correction of particular errors, and also about the systematization of legal standards of right register data primacy over real estate cadastre data.

Key words: Unified State Real Estate Register, data quality improvement, data reliability and integrity, data verification and correlation of USRER and SREC, right registration, cadastral registration.

REFERENCES

1. Lidovskiy, V. V. (2004). *Teoriya informatsii [Theory of information]*. Moscow: Sputnik Plyus Company [in Russian].

2. Fursov, V. A. (2006). *Lektsii po teorii informatsii [Lectures on information theory]*. N. A. Kuznetsova (Ed.). Samara: Samara State Aerospace University Publ. [in Russian].

3. Federal Law of July 13, 2015 No. 218-FZ. *On the Unified State Register of Real Estate*. Retrieved from ConsultantPlus online database [in Russian].

4. Federal Law of July 27, 2006 No. 149-FZ. *On information, information technologies and information protection*. Retrieved from ConsultantPlus online database [in Russian].

5. Government Order of the Russian Federation of December 01, 2012 No. 2236-r. *On the approval of the action plan ("road map") "Improving the quality of public services in the sphere of state cadastral registration of real estate and state registration of rights to real estate and transactions with it"*. Retrieved from ConsultantPlus online database [in Russian].

6. Order of Rosreestr of November 23, 2010 No. P/618. *On the organization of work to improve the quality of data from the unified state register of rights and the state real estate cadastre*. Retrieved from ConsultantPlus online database [in Russian].

7. Government Order of the Russian Federation of September 03, 2011 No. R/102. *On improving the quality of comparability of data of the unified state register of rights to real estate and transactions with it and the state real estate cadastre*. Retrieved from ConsultantPlus online database [in Russian].

8. Government order of the Russian Federation of January 22, 2013 No. R/4, (ed. June 18, 2013). *On improving the quality of comparability of data of the unified state register of rights to real estate and transactions with it and the state real estate cadastre on buildings, structures, construction in progress and premises*. Retrieved from ConsultantPlus online database [in Russian].

9. Commission of Rosreestr of April 10, 2014 No. 09-iskh/04028-GE/14. Retrieved from ConsultantPlus online database [in Russian].

10. Karpik, A. P., Kolmogorov, V. G., & Rychkov, A. V. (2013). Development of criteria for assessing the quality of cadastral data. *Izvestiya vuzov. Geodeziya i aerofotos"emka [Izvestiya vuzov. Geodesy and Aerophotography], 4/S*, 133–136 [in Russian].

11. Klyushnichenko, V. N., & Timofeeva, N. V. (2011). *Zemel'nyy kadastr [Land cadastre]*. V. N. Klyushnichenko (Ed.). Novosibirsk: SSGA [in Russian].

12. The report on the results of the expert and analytical exercise “Analysis of the completeness and reliability of information on real estate for the purpose of calculating property taxes” (taking into account the control measures of the Accounts Chamber of the Russian Federation and control and accounting bodies of the subjects of the Russian Federation. (2016). *Byulleten' Schetnoy palaty Rossiyskoy Federatsii [Bulletin of the Accounts Chamber of the Russian Federation], 6*, 235-294. Retrieved from http://audit.gov.ru/activities/bulleten/879/ [in Russian].

13. *Federal'naya baza znaniy Rosreestra [Federal Knowledge Base of Rosreestr]*. (n. d.). Retrieved from at http://support.kadastr.ru/.

14. Order of the Ministry of Economic Development of the Russian Federation of February 04, 2010 No. 42, (ed. January 20, 2016). *On Approving the Procedure for Maintaining the State Real Estate Cadastre*. Retrieved from ConsultantPlus online database [in Russian].

15. Order of the Ministry of Economic Development of the Russian Federation of December 23, 2013 No. 765 (ed. March 26, 2015). *On approval of the rules for maintaining the Unified State Register of Rights to Real Estate and Transactions with it, the composition of the registration*

number, the procedure for assigning real estate rights and transactions with real estate to real estate objects that are not cadastral according to the procedure established by the legislation of the Russian Federation Number, forms of certificate of state registration of right and special registration inscription on documents, requirements for completing the certificate of state registration of rights and a special registration inscription, as well as requirements for the format of a special registration inscription in electronic form. Retrieved from ConsultantPlus online database [in Russian].

16. Federal Law of July 21, 1997 No. 122-FZ (ed. July 3, 2016). *On state registration of rights to real estate and transactions with it*. Retrieved from ConsultantPlus online database [in Russian].

17. Federal Law of July 24, 2007 No. 221-FZ (ed. July 3, 2016). *On the state real estate cadastre*. Retrieved from ConsultantPlus online database [in Russian].

18. Commission of Rosreestr of September 18, 2015 No. 09-iskh/13614-ms/15. Retrieved from ConsultantPlus online database [in Russian].

19. Order of Rosreestr and The Federal Tax Service of August 12, 2011 No. P/302/MMV-7-11/495. *Ob utverzhdenii Poryadka obmena svedeniyami v elektronnom vide o zaregistrirovannykh pravakh na nedvizhimoe imushchestvo (v tom chisle zemel'nye uchastki) i sdelkakh s nim, pravoobladatelyakh nedvizhimogo imushchestva i ob ob"ektakh nedvizhimogo imushchestva [On approval of the procedure for the exchange of information in electronic form on the registered rights to real estate (including land plots) and transactions with it, the owners of real property and on real estate objects]*. Retrieved from ConsultantPlus online database [in Russian].

20. Commission of Rosreestr of May 22, 2014 No. 10-iskh/0578-MS/14. Retrieved from ConsultantPlus online database [in Russian].

21. Kogalovskiy, M. R. (2002). *Entsiklopediya tekhnologiy baz dannykh [Encyclopedia of Database Technologies]*. Moscow: Finance and Statistics [in Russian].

22. Graber, M. (1997). *Spravochnoe rukovodstvo po SQL [SQL Reference Guide]*. Moscow: Lori [in Russian].

23. Digo, S. M. (1995). *Proektirovanie i ispol'zovanie baz dannykh [Design and use of databases]*. Moscow: Finance and Statistics [in Russian].

24. Kuznetsov, S. D. (1996). SQL Relational Database Language Standards: An Overview. *SUBD [SUBD]*, 2, 6–36. Retrieved from at http://citforum.ru/database/articles/art_2.shtml.

25. Federal Law of July 27, 2010 No. 210-FZ. *On the organization of the provision of state and municipal services*. Retrieved from ConsultantPlus online database [in Russian].

Received 13.07.2017

RATIONAL LAND USE AND BASIC CONDITION OF ITS REALIZATION

Valeriy B. Zharnikov
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D., Professor, Department of Cadastre and Territorial Planning, phone: (383)361-05-66, e-mail: vestnik@ssga.ru

Rational land use as an aim, a task and a principle of modern land use was formulated by the classics of domestic land management in the period of land relation socialization and so far plays determinative role in the use of land resources. Rational land use realization implies first accordance with acting legislation, and also optimal use of land resources and each particular land use in relation to one or several basic parameters: economical, ecological, technological, social. The complete solution of similar problem has not been created by now, that is related to taking into account significant number of conditions – factors and formation of integral rationality parameter. The present article is devoted to this problem.

Key words: rational land use, organizational legal groundwork, economical, ecological, technological and social conditions, criteria, indicators.

REFERENCES

1. Pereslegin S. (2009). *Novye karty budushchego, ili anti-rend [New maps of the future, or anti-rend]*. Moscow: AST, SPb: Terra Fantastica [in Russian].

2. Karpik, A. P., Osipov, A. G., & Murzintsev, P. P. (2010). *Upravlenie territoriey v geoinformatsionnom diskurse [Territory management in geoinformation discourse]*. Novosibirsk: SSGA [in Russian].

3. Kaznacheev, V. P., Kisel'nikov, A. A., & Mingazov, I. F. (2005). *Noosfernaya ekologiya i eko-nomika cheloveka. Problemy "sfinksa XXI veka" [Noospheric ecology and human economics. Problems of the "Sphinx of the XXI century"]*. V. P. Kaznacheev (Ed.). Novosibirsk: Center of Hygiene and Epidemiology [in Russian].

4. Kaznacheev, V. P. (1991). *Fenomen cheloveka [The phenomenon of man]*. Novosibirsk: Novosibirsk Publishing House [in Russian].

5. Dobrynin, A. I., Dyatlov, S. A., & Tsyrenova, E. D. (1991). *Chelovecheskiy kapital v tranzitivnoy ekonomike [Human capital in a transitive economy]*. St. Petersburg: Science [in Russian].

6. Danilov-Danil'yan, V. I., & Khosev, K. S. (2000). *Ekologicheskiy vyzov i ustoychivoe razvitie [Ecological challenge and sustainable development]*. Moscow: Progress-Tradition [in Russian].

7. *Development and Environment*. (1992). New York: Oxford sity Dress.

8. Stepin, V. S. (2000). *Teoreticheskoe znanie. Struktura, istoricheskaya evolyutsiya [Theoretical knowledge. Structure, historical evolution]*. Moscow: Progress-Tradition [in Russian].

9. Luk'yanchikov, N. N., & Potravnyy, I. M. (2007). *Ekonomika i organizatsiya prirodopol'zovaniya [Economics and organization of nature management]* (3rd ed.). Moscow: Yuniti-Dana [in Russian].

10. Markov, Yu. G., Turchenko, V. N., Chirkin, E. A., & Yurkov, S. A. (1995). *Sotsial'no-pravovye mekhanizmy prirodopol'zovaniya [Social and legal mechanisms of nature use]*. Novosibirsk: SB RAS, SPSTB [in Russian].

11. Erofeev, B. V. (1998). *Zemel'noe pravo [Land law]*. G. V. Chubukov (Ed.). Moscow: New Lawyer [in Russian].

12. Volkov, S. N. (2014). *Zemleustroystvo [Land management]*. Moscow: GUZ [in Russian].

13. Kurbanov, E. A., & Yakovlev, I. A. (2001). *Lesoustroystvo. Mezhdunarodnye aspekty ustoychivogo upravleniya lesami [Forest management. International aspects of sustainable forest management]*. Yoshkar-Ola: MarSTU [in Russian].

14. Kozlovskoy, O. V. (Ed.). (2003). *Indikatory ustoychivogo razvitiya Tomskoy oblasti [Indicators of sustainable development in the Tomsk region]* (2nd ed.). Tomsk: STT [in Russian].

15. Psarev, V. I., Psareva, T. V., Sushentsova, N. V., & Goncharov, I. A. (2010). *Metodika formiro-vaniya i analiza kompleksnykh programm sotsial'no-ekonomicheskogo razvitiya munitsipal'nykh obrazovaniy [Methodology of formation and analysis of complex programs of social and economic development of municipalities]*. V. I. Psareva, & N. V. Sushentsova (Eds.). Novosibirsk: MASS [in Russian].

16. Bocharova, A. A., & Zharnikov, V. B. (2012). Main conditions of rational use of lands of wood fund. *Vestnik SGGA [Vestnik SSGA]*, 3(19), 69–77 [in Russian].

17. Zharnikov, V. B. (2015). Rational land use as a problem of GIS spatial analysis. In *Sbornik trudov ROEE-2015: XIII mezhdunar. nauch. prakt. konf. "Teoreiya i praktika ekologicheskogo regulirovaniya prirodopol'zovaniya i okhrany okruzhayushchey sredy" [Proceedings of RSEE-2015: 13th International Conference of the Russian Society for Ecological Economics "Natural Resource Management and Enviromental Protection: Theory and Practice of Economic Regulation"]* (pp. 442–448). Kazan [in Russian].

18. Bocharova, A. A. (2014). Razrabotka metodiki ratsional'nogo ispol'zovaniya lesnykh uchast-kov v sostave zemel' lesnogo fonda [Development of methods for the rational use of forest plots in the composition of forest lands]. *Extended abstract of candidate's thesis*. Novosibirsk [in Russian].

19. Sedykh, V. N. (2005). *Paradoksy v reshenii ekologicheskikh problem Zapadnoy Sibiri [Paradoxes in solving environmental problems in Western Siberia]*. I. Yu. Koropatchinskogo (Ed.). Novosibirsk: Science [in Russian].

20. Bogolyubov, S. A., & Zolotova, O. A. (2016). *Zemel'noe zakonodatel'stvo [Land legislation]* (2nd ed.). Moscow: Prospekt. Retrived from www.prospekt.org [in Russian].

21. *Skhema territorial'nogo planirovaniya munitsipal'nogo rayona [Scheme of territorial planning of the municipal district]*. (n. d.). Retrived from http://kochenevo.nso.ru/page/5697 [in Russian].

22. Babitskiy, A., Zholobova, M., Myazina, E., Napalkova, A., Prelovskaya, V., & Rusyaeva P. (2015). Growing cities: rating. *RBK [RBC]*, 4, 27–35[in Russian].

23. Anekkev, V. V., & Vladimirov, V. V. (2002). *Gradostroitel'nye problemy sovershenstvovaniya administrativno-territorial'nogo ustroystvo [Urban development problems of improving the administrative-territorial arrangement]*. Moscow: Editorial URSS [in Russian].

Received 05.05.2017

INVESTIGATION OF POSSIBILITY OF SPACE PHOTO APPLICATION FOR BORDER DETERMINATION OF SPECIAL TERRESTRIAL CONDITION ZONES

Ol'ga F. Torsunova
Siberian State University Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Ph. D. Student, Department of Cadastre and Territorial Planning, phone: (383)344-31-73, e-mail: goryanova.olga@mail.ru

In the article the author considers the possibility to use space photos, obtained by means of remote sensing of the Earth, for border determination of special terrestrial condition zones for the purpose of effective federal and municipal control. The timeliness of the topic is proved by the fact that the Unified State Register does not contain the information about the special terrestrial use zones, that leads to city-planning and cadastral errors, and involves violation of exploitation conditions of real estate, for which these zones are established. By means of such open information systems as Rosreestr and Yandex there was performed an investigation of visibility of control border points of land parcels and capital construction based on them and displayed on space shots. The investigation showed that in the process of zoning it is reasonable to apply information, obtained by space surveying.

Key words: special terrestrial condition zone, zoning, land parcel, real estate cadastre, space survey, space shot, satellite, public cadastral map, terrestrial planning.

REFERENCES

1. Avrunev, E. I., Kalenitsky, A. I., & Klyushnichenko, V. N. (2015). Problems of cadastral activity. *Izvestiya vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *5/S*, 99–103 [in Russian].

2. Parkhonenko, I. V. (2015). State land control informational model. *Izvestiya vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *5/S*, 90–96 [in Russian].

3. Tararin, A. M., & Tararina, E. G. (2016). On the basis of cartographic cadastral maps. In *Tezisy dokladov nauchno-tekhnicheskoy konferentsii: Velikie reki 2016 [Proceedings of Scientific and Technical Conference: Great Rivers 2016]* (pp. 374–377). Nizhniy Novgorod [in Russian].

4. Mitrofanova, N. O., & Sukharnikiva, Ya.V. (2013). Improvement of quality and availability of state services in state cadastral registration and state registration of real property rights in Novosibirsk region. *Vestnik SGGA [Vestnik SSGA]*, *2*(22), 44–52 [in Russian].

5. Karpik, A. P. (2014). Analysis of the state and problems of geoinformation support of territories. *Izvestiya vuzov. Geodeziya i aerofotos"emka [Izvestia Vuzov. Geodesy and Aerophotography]*, *4/S*, 3–7 [in Russian].

6. Kudashev, E. B. (2003). Digital library of satellite data: access to collections of environmental monitoring. *Kosmicheskaya nauka i tekhnologiya [Aerospace Science and Technology]*, *5/6*, 207–210 [in Russian].

7. Golden, S. A. (2008). Remote sensing of the Earth from space and sustainable development of society. *Voprosy elektromekhaniki. Kosmicheskie apparaty dlya distantsionnogo zondirovaniya Zemli [Questions of Electromechanics. Spacecraft for Remote Sensing of the Earth]*, *104*, 4–5 [in Russian].

8. Aien, M. Kalantari, A. Rajabifard, I. P. Williamson, & D. Shojaei (2012). Developing and testing a 3D cadastral data model a case study in Australia. In *XXII ISPRS Congress: Vol. I–4. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. Australia: Melbourne.

9. Panarin, V. A., & Panarin, R. V. (2009). Application of space images in the municipal administration of urbanized territories for the tasks of spatial planning. *Geomatika [Geomatics]*, *3*, 40–55 [in Russian].

10. *Agricultural Applications with SAR Data. Module 3202: Biosphere* / Riedel T. Eckardt R. Earth Observation Institute of Geography, Friedrich-Schiller-University Jena / SAR Edu – remote sensing education initiative. Retrived from: https://saredu. dlr.de/unit/agriculture.

11. *Sentinel–1. ESA Sentinel online.* (n. d.). Retrived from: https://sentinel.esa.int/web/ sentinel/missions/sentinel-1.

12. Space vehicles with optico-electronic systems of remote sensing. (2009). *Geomatika [Geomatics]*, *1*, 84–92 [in Russian].

13. Fauvel, M., Tarabalka, Y., Benediktsson, J. and other. (2013). Advances in spectral-spatial classification of hyperspectral images. *Proc. IEEE, 101*(3 SI), 652–675.

14. Jakob J. van Zyl. (n. d.). *Radar Remote Sensing for Earth and Planetary Science*. Pasadena: Jet Propulsion Laboratory. Retrived from: http://www.its.caltech.edu/~ee157/lecture_note/Radar.pdf.

15. Brisco, B., & Brown, R. J. (1998). Agricultural Applications with Radar. In: F. M. Henderson, A. J. Lewis (Eds.), *Principles & Applications of Imaging Radar. Manual of Remote Sensing* (3rd ed.): *Vol. 2*. New York: Wiley & Sons.

16. Order of the Ministry of Economic Development of Russia of March 23, 2016 No. 163. *On approval of the Requirements for the coordinate system, the accuracy of determining the coordinates of the characteristic points of the boundaries of the zone with special conditions for the use of the territory, the format of an electronic document containing information on the boundaries of the zone with special conditions for the use of the territory*. Retrieved from: http://www.consultant.ru/document/cons_doc [in Russian].

17. Order of the Ministry of Economic Development of the Russian Federation of July 28, 2011 No. 375. *On the definition of requirements for maps and plans, which is the cartographic basis of the state real estate cadastre*. Retrieved from ConsultantPlus online database [in Russian].

18. *Portal of services "Public cadastral map"*. (n. d.). Retrived from: http://mapp.rosreestr.ru/PortalOnline/ [in Russian].

19. Khlebnikov, E. P., & Miroshnikov, O. A. (2015). Analysis of the content publicly cadastral maps of regions of the Russian Federation. *Vestnik SGUGiT [Vestnik SSUGT]*, *2*(34), 127–142 [in Russian].

20. Zharnikov, V. B., Gagarin, A. I., & Lebedeva, T. A. (2014). Prioritete indicators of sustainable development of territories. *Vestnik SGGA [Vestnik SSGA], 4*(28), 57–65 [in Russian].

21. Karpik, A. P. (2013). Development of the method of qualitative and quantitative assessment of the inventory information. *Izvestia vusov. Geodeziya i aerofotos"emka [Izvestiya Vuzov. Geodesy and Aerophotography], 4*, 137–142 [in Russian].

Received 04.07.2017

OPTICS, OPTICAL AND ELECTRONIC DEVICES AND COMPLEXES

OPTICAL AND ACOUSTIC TRAPS

Igor V. Minin
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plahotnogo St., Dr. Sc., Professor, Department of Metrology and Technology of Optical Production, e-mail: prof.minin@gmail.com

Oleg V. Minin
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plahotnogo St., Dr. Sc., Professor, Department of Metrology and Technology of Optical Production, e-mail: prof.minin@gmail.com

The paper provides the review of optical and acoustic traps on the basis of optical and acoustic tweezers. The principles of their work, including application of new focusing devices – dielectric and acoustic the particles forming «photon jets» are considered. Comparison of optical traps with acoustic traps is resulted. Scopes of use of optical and acoustic traps are considered. Optical and acoustical tweezers are used to grip and manipulate both individual cells and groups of cells, molecules, microparticles, etc.

Key words: optical tweezers, optical trap, acoustic trap, sound tweezers, manipulation microparticles, optical radiation, acoustic radiation, radiating force, photon jet.

REFERENCES

1. Bockelmann, U., Thomen, P., Essevaz-Roulet, B., Viasnoff, V., & Heslot, F. (2016). Unzipping DNA with Optical Tweezers: High Sequence Sensitivity and Force Flips. *Biophys. J. Elsevier, 82*(3), 1537–1553.

2. Wright, W. H., Sonek, G. J., & Berns, M. W. (1994). Parametric study of the force on a microsphere held by optical tweezers. *Appl. Opt., 33*(9), 1735–1748.

3. Karel, Svoboda, & Steven, M. (1994). Block Biological applications of optical forces. *Annu. Rev. Biophys. Diomol. Struc., 23*, 247–285.

4. Ashkin, A. (1970). Acceleration and trapping of particles by radiation pressure. *Phys. Rev. Lett., 4*(4), 156–159.

5. Ashkin, A., & Dziedzic, J. M. (1986). Observation of a single-beam gradient force optical trap for dielectric particles. *Opt. Lett., 11*(5), 288–291.

6. Ashkin, A., & Dziedzic, J. M. (1987). Optical Trapping and Manipulation of Viruses and Bacteria. *Science, 235*, 1517–1520.

7. Yavorsky B. M., & Detlaf, A. A. (1965). *Spravochnik po fizike [The directory on the physicist]* (3nd ed.). Moscow: Science [in Russian].

8. Born, M. & Volf, E. (1973). *Osnovy optiki [Osnovy of optics]* (2nd ed.). Moscow: Science [in Russian].

9. Neuman, K. C., & Block, S. M. (2004). Optical trapping. *Review of Scientific Instruments, 75*, 2787–2809.

10. Cizmar, T., Davila, Romero, L. C., Dholakia, K., & Andrews, D. L. (2010). Multiple optical trapping and binding: new routes to self-asstmbly. *Journal of Physics B: Atomic, Molecular and Optical Physics, 43*, P. 102001.

11. Nieminen, T. A., Loke, V. L. Y., Knoner, G., & Branczyk, M. (2007). Toolbox for calculation of optical forces and torques. *PIERS Online, 3*, p. 338.

12. US Patent No. 370279. Apparatuses for trapping and accelerating neutral particles.

13. Ghislain, L. P., & Webb, W. W. (1993). Scanning-force microscope based on an optical trap. *Opt. Lett., 18*(19), 1678–1680. doi: 10.1364/OL.18.001678.

14. Zemanek, P. et al. (1998). Optical trapping of Rayleigh particles using a Gaussian standing wave. *Opt. Commun., 151*, 273–285.

15. Barton, J., & Alexander, D. (1989). Fifth-order corrected electromagnetic field components for a fundamental Gaussian beam. *J. Appl. Phys.*, *66*, 2800–2802.

16. Minin, I. V., & Minin, O. V. *Patent RF No. 160834. Subwave optical trap in a floor of a standing wave*. Novosibirsk: IP Russian Federation.

17. Pacheco-Pena, V., Beruete, M., Minin, I. V., & Minin, O. V. (2014). Terajets produced by 3D dielectric cuboids. *Appl. Phys. Lett., 105*, P. 084102. Retrived from http://dx.doi.org/10.1063/l.4894243.

18. Minin, I. V., Minin, O. V., & Geints, Y. E. (2015). Localized EM and photonic jets from non-spherical and non-symmetrical dielectric mesoscale objects: Brief review. *Ann. Phys.* (Berlin), *527*(7–8), 491–497. doi 10.1002/andp.201500132.

19. Minin, I. V., & Minin, O. V. (2014). Fotonika of the isolated dielectric particles of the any three-dimensional form – a new direction of optical information technologies. *Vestnik IGU. Seriya: Informatsionnye tekhnologii [Bulletin to the NGU. Series: Information Technologies]*, *12*(4), 69–70. Retrived from http://www.nsu.ru/xmlui/handle/nsu/7717 [in Russian].

20. Minin I. V., & Minin O. V. *Patent RF No. 161207. Device for formation of an optical trap in the form of a photon hook* [in Russian].

21. Wu, F. (2010). Generation of self-imaged optical bottle beam by using axicons. *Proc. of SPIE, 7721*(1), 77211C-1–77211C-6.

22. Tikhonenko, V. (1996). Excitation of vortex solitons in a Gaussian beam configuration. *Optics Communications*, *126*(1), 108–112.

23. Tauro, S., Banas, A., Palima, D., & Gltickstad, J. (2010). Dynamic axial stabilization of counterpropagating beam-traps with feedback control. *Optics Express, 18*(17), 18217–18222. doi 10.1364/OE.18.018217.

24. Mudry, E., Le Moal, E., Ferrand, P., Chaumet, P. C., & Sentenac, A. (2010). Isotropic diffraction limited focusing using a single objective lens. *Physical Review Letters, 105*(20), P. 203903.

25. *Optical conveyor belt.* (n. d.). Retrived from http://www.isibrno.cz/omitec/index.php?action=besscbelt.html.

26. Minin, I. V., & Minin, O. V. *Patent RF No. 167405. Mesoscale an optical trap in a floor of a standing wave on the basis of two counter bunches*. Novosibirsk: IP Russian Federation.

27. US Patent No. 6055106. Apparatus for applying optical gradient forces.

28. Wu, J. (1991). Acoustic tweezers. *J. Acoustical Soc. Am., 5*, 2140–2143.

29. Baresch, D., Thomas, J.-L., & Marchiano, R. (2016). Observation of a single-beam gradient force acoustical trap for elastic particles: acoustical tweezers. *Physical Review Letters, 116*, P. 024301.

30. Bruus, H. (2012). Acoustofluidics 7: The acoustic radiation force on small particles. *Lab Chip. The Royal Society of Chemistry*, *12*(6), 1014–1021.

31. Démoré, C. E. M., Dahl, P. M., Yang, Z., Glynne-Jones, P., Melzer, A., Cochran, S., MacDonald, M. P., & Spalding, G. C. (2014). *Acoustic Tractor Beam. Phys. Rev. Lett. American Physical Society*, *112*(17), P. 174302.

32. Baresch, D., Thomas, J.-L., Marchiano, R. (2016). Observation of a Single-Beam Gradient Force Acoustical Trap for Elastic Particles: Acoustical Tweezers: Classical Physics; Soft Condensed Matter. *Phys. Rev. Lett.*, *116*(2), P. 024301.

33. Ding, X., Lin, S.-C.S., Kiraly, B., Yue, H., Li, S., Chiang, I.-K., Shi, J., Benkovic, S. J., & Huang, T. J. (2012). On-chip manipulation of single microparticles, cells, and organisms using surface acoustic waves. *Proc. Natl. Acad. Sci*., *109*(28), 11105–11109.

34. Démoré, C. E. M., Dahl, P. M., Yang, Z., Glynne-Jones, P., Melzer, A., Cochran, S., MacDonald, M. P., & Spalding, G. C. (2014). Acoustic Tractor Beam. *Phys. Rev. Lett. American Physical Society*, *112*(17), P. 174302.

35. Foresti, D., Nabavi, M., Klingauf, M., Ferrari, A., & Poulikakos, D. (2013). Acoustophoretic contactless transport and handling of matter in air. *Proc. Natl. Acad. Sci*., *110*(31), 12549–12554.

36. Zhang, P., Li, T., Zhu, J., Zhu, X., Yang, S., Wang, Y., Yin, X., & Zhang, X. (2014). Generation of acoustic self-bending and bottle beams by phase engineering. *Nat Commun*., *5*.

37. Baresch, D., Thomas, J.-L., & Marchiano, R. (2016). Observation of a Single-Beam Gradient Force Acoustical Trap for Elastic Particles: Acoustical Tweezers: Classical Physics; Soft Condensed Matter. *Phys. Rev. Lett.*, *116*(2), P. 024301.

38. Lam, K. H., Hsu, H.-S., Li, Y., Lee, C., Lin, A., Zhou, Q., Kim, E. S., & Shung K. K. (2013). Ultrahigh frequency lensless ultrasonic transducers for acoustic tweezers application. *Biotechnol. Bioeng.*, *110*(3), 881–886.

39. Zhang, P., Li, T., Zhu, J., Zhu, X., Yang, S., Wang, Y., Yin, X., & Zhang, X. (2014). Generation of acoustic self-bending and bottle beams by phase engineering. *Nat Commun.*, *5*.

40. Baresch, D., Thomas, J.-L., & Marchiano, R. (2016). Observation of a Single-Beam Gradient Force Acoustical Trap for Elastic Particles: Acoustical Tweezers: Classical Physics; Soft Condensed Matter. *Phys. Rev. Lett.*, *116*(2), P. 024301.

41. Silva, G. T., & Baggio, A. L. (2015). Designing single-beam multitrapping acoustical tweezers. *Ultrasonics*, *56*, 449–455.

42. Marzo, A., Seah, S. A., Drinkwater, B. W., Sahoo, D. R., Long, B., & Subramanian, S. (2015). Holographic acoustic elements for manipulation of levitated objects. *Nat Commun.*, *6*.

43. Baresch, D., Thomas, J.-L., & Marchiano, R. (2016). Observation of a Single-Beam Gradient Force Acoustical Trap for Elastic Particles: Acoustical Tweezers: Classical Physics; Soft Condensed Matter. *Phys. Rev. Lett.*, *116*(2), P. 024301.

44. Zhang, P., Li, T., Zhu, J., Zhu, X., Yang, S., Wang, Y., Yin, X., & Zhang, X. (2014). Generation of acoustic self-bending and bottle beams by phase engineering. *Nat Commun.*, *5*.

45. Gorkov, L. P. (1961). About the forces acting on a small particle in an acoustic floor in an ideal liquid. *Doklady AN SSSR [Reports AN USSR]*, *140*(1), 88–91 [in Russian].

46. Hertz, H. M. (1995). Standing-wave acoustic trap for non intrusive positioning of microparticles, *J. Appl. Phys.*, *78*, 4845–4849.

47. Knyazko, N. N., Makarova, E. D., & Rabizhanovich, A. D. (2008). Ultrasonic flowing fractionirovanie particles of the various nature. 2. Principles of a choice of optimum conditions fractionirovanie unicomponent particles of the different nature and non-uniform (two-componental) particles. Limiting parameters of division. *Nauchnoe priborostroenie [Scientific Instrument Making]*, *18*(1), 40–55 [in Russian].

Received 24.05.2017

EVALUATION OF DYNAMICS OF WATER USE OF SUBJECTS OF WESTERN SIBERIA

Viktoria S. Nadtochii
Omsk State Agrarian University named after P. A. Stolypina, 644008, Russia, Omsk, 1 Institutskaya Sq., Senior Lecturer, Department of Environmental Engineering, Water Use and Water Resources Protection, phone: (965)988-74-13, e-mail: s_victory@list.ru

In the article the estimation of the temporal dynamics of water use and the regularities of their changes at the modern stage of economic activity in the regions of Western Siberia is given. Quantitative characteristics and reflect the analysis of water availability in the study area and population are presented. Temporal dynamics of the main characteristics of water use in river basins and in the context of the Federation is considered. The analyzed sources are computational and analytical materials for the study of surface water resources of river basins, including in the context of the Federation Subjects. On the basis of state statistical reports was performed the evaluation of water resources areas, water consumption and water removal for 2000-2015. The analysis showed that the marked features of the dynamics of water depend on moisture conditions, the structure of the underlying surface of river basins, as well as the level of economic activity of Federation Subjects in Western Siberia. Taking into account the importance of complying to the principles of regional nature use, the trend of the total volume growth of water withdrawn by individual regions should also be taken into account in working out the schemes of complex use and protection of water resources.

Key words: water resources, water consumption, water disposal, use of water resources, dynamics of water use, volume of wastewater discharge.

REFERENCES

1. *Vodnye resursy SSSR i ih ispol'zovanie [Water resources of the USSR and their use]*. (1987). Leningrad: Gidrometeoizdat [in Russian].
2. Davydov, L. K. (1955). *Gidrografija SSSR (vody sushi): Ch. 2*, Gidrografija rajonov *[Hydrography of the USSR (land water): Part 2, Hydrography of districts]*. Leningrad: LGU Publ. [in Russian].
3. Plitkin, G. A. (1976). *Vodnyj balans Zapadnoj Sibiri [Water balance of Western Siberia]*. P. S. Kuzin (Ed.). Leningrad: Gidrometeoizdat [in Russian].
4. Karnatsevich, I. V., Mezentseva, O. V., Tusupbekov, Zh. A., & Bikbulatova, G. G. (2007). *Vozobnovljaemye resursy teplovlagoobespechennosti Zapadno-Sibirskoj ravniny i dinamika ih harakteristi. [Renewable resources of heat and moisture availability of the West Siberian Plain and the dynamics of their characteristics]*. Omsk: OmGAU Publ. [in Russian].
5. Akimov, V. N. (1999). *Spravochnik. Standartnye terminy v vodnom hozjajstve [Directory. Standard terms in the water industry]*. H. H. Mikheyev (Ed.). Moscow: NIA-Priroda [in Russian].
6. Reimers, N. F. (1990) *Prirodopol'zovanie: Slovar'–spravochnik [Nature management. Dictionary]*. Moscow: Mycl' [in Russian].

7. Ryapolova, N. L., Tusupbekov, Zh. A., & Nadtochiy, V. S. (2015). Influence of anthropogenic factors on the formation of the flow of lakes located on the territory of the West Siberian Plain. *Omckii nauchnyi vectnik [Omsk Scientific Bulletin]*, *1*, 218–221 [in Russian].

8. Avakyan, A. B., & Shirokov, V. M. (1990). *Kompleksnoe ispol'zovanie i ohrana vodnyh resursov [Integrated use and protection of water resources]*. Minsk [in Russian].

9. Shabanov, V. V, Galyamina, I. G., & Beglarova, E. S. (1994). *Kompleksnoe ispol'zovanie i ohrana vodnyh resursov [Integrated use and protection of water resources]*. Moscow: Kolos [in Russian].

10. Arkhipov, S. A., Vdovin, V. V., Mizerov, B. V., & Nikolaev, V. A. (1988). *Zapadno-Sibirskaja ravnina [The West Siberian Plain]*. Moscow: Nauka [in Russian].

11. Zemtsov, A. A., Mizerov, B. V., & Nikolaev, V. A. (1988). *Rel'ef Zapadno-Sibirskoj ravniny [Relief of the West Siberian Plain]*. Novosibirsk: Nauka, Siberian Branch [in Russian].

12. Grigoryev, A. A., & Budyko, M. I. (1959). *Classification of climates of the USSR. Izvectiia AN SSSR [News of AS USSR]*, 3, 3–19 [in Russian].

13. *Spravochnik po klimatu SSSR: Vyp. 17, ch. 2, Temperatura vozdukha i pochvy [Guide to the climate of the USSR: I. 17, Part 2, Temperature of air and soil]*. (1965). Leningrad: Gidrometeoizdat [in Russian].

14. Vodogretckiy, V. E. (Ed). (1973). *Resursy poverhnostnyh vod SSSR: T. 15, Vyp. 3 [Resources of surface waters of the USSR: Vol. 15, I. 3]*. Leningrad: Gidrometeoizdat [in Russian].

15. Vodogretckiy, V. E. (Ed). (1972). *Resursy poverhnostnyh vod SSSR: T. 15, Vyp. 2 [Resources of surface waters of the USSR: Vol. 15, I. 2]*. Leningrad: Gidrometeoizdat [in Russian].

16. Mikhailova, N. I., & Loginovskaya, A. N. (2011). Estimation of hydrological network condition of the Irtysh river basin in Kasakhstan. *Vestnik SGUGiT [Vestnik SSUGT]*, *2*(15), 88–96 [in Russian].

17. Order of the Government of the Russian Federation dated August 27, 2009 No. 1235 (ed. December 28, 2010). *Water Strategy of the Russian Federation for the period until 2020*. Retrieved from Consultant online database [in Russian].

18. *Federal'naja sluzhba gosudarstvennoj statistiki [Federal Service of State Statistics Electronic resource]*. (n. d.). Retrived from http://www.gks.ru/wps/wcm/connect/rosstat_ main/rosstat/ ru/statistics [in Russian].

19. Belonenko, G. V., Rotanova, I. N., Tsymbaley, Yu. M., Andreeva, I. V, & Vedukhina, V. G. (2010). Cartographic analysis of the spatio-temporal distribution of the elements of the hydrologic cycle in the basin of the Ob River. *Mir nauki, kul'tury i obrazovaniia [The World of Science, Culture, Education]*, *1*(20), 95–99 [in Russian].

20. State report. (ed. 2008). *On the state and use of water resources of the Russian Federation in 2007*. Moscow: NIA-Priroda [in Russian].

21. State report. (ed. 2009). *On the state and use of water resources of the Russian Federation in 2008*. Moscow: NIA-Priroda [in Russian].

22. State report. (ed. 2010). *On the state and use of water resources of the Russian Federation in 2009*. Moscow: NIA-Priroda [in Russian].

23. State report. (ed. 2014). *On the state and use of water resources of the Russian Federation in 2013*. Moscow: NIA-Priroda [in Russian].

24. State report. (ed. 2016). *On the state and use of water resources of the Russian Federation in 2015*. Moscow: NIA-Priroda [in Russian].

25. Belonenko, G. V., & Popova, N. B. (2007). Ecological and geographical conditions of water use in Western Siberia. *Vodnoe khozyaystvo Rossii: problemy, tekhnologii, upravlenie [Water Sector of Russia: Problems, Technologies, Management]*, *3*, 25–32 [in Russian].

26. Blagoverov, B. G. (1976). Methodological issues of substantiation of perspective water consumption in industry. *Vodnye recurcy [Water Management]*, 5, 120–126 [in Russian].

27. Kreimer, M. A. (2013). Harmonization of nature use and nature protection activity. *Vestnik SGGA [Vestnik SSGA]*, *2*(22), 61–77 [in Russian].

28. Kaveshnikov, N. T., Karev, V. B., Kaveshnikov, A. N. (2006). *Upravlenie prirodopol'zovaniem [Nature management]*. Moscow: KolosS [in Russian].
29. Bobylev, S. N. (2014). *Jekonomika prirodopol'zovanija [Economics of nature management]*. Moscow: INFRA-M [in Russian].
Received 15.06.2017

ESTIMATION OF GEOGRAPHICAL PARAMETERS OF LANDSCAPE PROVINCES IN WEST-NORTH SIBERIA

Natalia B. Popova
Siberian Transport University, 630049, Russia, Novosibirsk, 191 Dusi Koval'chuk St., Dr. Sc., Professor, Department of Economy of Transport, phone: (913)939-16-89, e-mail: pnb1512@yandex.ru

Natalia L. Ryapolova
Omsk State Agrarian University named after P. A. Stolypin, 644008, Russia, Omsk, 1 Institutskaya Square, Senior Lecturer, Department of Environmental Engineering, Water Management and Protection of Water Resources, phone: (913)655-62-97, e-mail: natalyaan1986@rambler.ru

Ecological and geographical conditions of geosystems' forming and functioning give notion about genetic features of natural complexes, their state and ecological potential. The private methods application of geosystem components' quantitative estimation of ecological and geographical parameters – that is ecological capacity and techno-capacity – reasonably demands differentiation of methodical approaches within landscape provinces. According to the principles of well-balanced land use the economical activity and technogenic burden on a particular territory must not exceed recovering potential within geosystems, that is, ecological techno-capacity of the territory. That means there is a necessity of environmental components' condition estimation on the level of landscape provinces and the study of ecological and geographical conditions of their formation and functioning. The article shows methodical approach and calculation results for definition of ecological and geographical parameters and features of landscape provinces of the region.

Key words: ecological capacity, techno-capacity, ecological and geographical zones, landscape provinces, heat and water resources, moisture coefficient, ground air, surface water, phytocenosis.

REFERENCES

1. Sochava, V. B. (1978). *Vvedenie v uchenie o geosistemakh [Introduction to the doctrine of geosystems]*. Novosibirsk: Nauka [in Russian].
2. Grigor'ev, A. A. (1966). *Zakonomernosti stroeniya i razvitiya geograficheskoy sredy [Regularities of structure and development of the geographical environment]*. Moscow: Mysl' [in Russian].
3. Demek, Ya. (1977). *Teoriya sistem i izuchenie landshafta [Systems theory and the study of landscape]*. Moscow: Progress [in Russian].
4. Semenov, Yu. M., & Suvorov, E. G. (2007). Geosystems and comprehensive physical geography. *Geografiya i prirodnye resursy [Geography and Natural Resources]*, *3*, 11–19 [in Russian].
5. Bazilevich, N. I., Grebenshchikov, O. S., & Tishkov, A. A. (1986). *Geograficheskie zakonomernosti struktury i funkcionirovaniya ehkosistem [Geographical regularities of structure and functioning of ecosystems]*. Moscow: Nauka [in Russian].

6. Bulatov, V. I., & Vinokurov, Yu. I. (1989). *Landshaftnaya indikaciya dlya racional'nogo ispol'zovaniya prirodnyx resursov [Landscape display for the rational use of natural resources]*. Moscow: MFGO [in Russian].

7. Mikheev, V. S. (2001). *Landshaftnyy sintez geograficheskikh znaniy [Landscape synthesis of geographic knowledge]*. Novosibirsk: Nauka [in Russian].

8. Vinokurov, Yu. I. Tsimbaley, Yu. M., & Krasnoyarova B. A. (2005). Physico-geographical regionalization of Siberia as the basis for the development of regional systems of nature management. *Polzunovskiy vestnik [Vestnik of Polzunov]*, *4*(2), 3–13 [in Russian].

9. Belonenko, G. V., Popova, N. B., & Tusupbekov, Zh. A. (2012). *Ekologo-geograficheskie usloviya transportnogo osvoeniya Zapadnoj Sibiri [Ecological and geographical conditions of the transport development in Western Siberia]*. Novosibirsk: SGUPS [in Russian].

10. Popova, N. B. (2001). *Ekologo-geograficheskie usloviya prirodopol'zovaniya v zone vliyaniya Transsibirskoj magistrali (Zapadnaya Sibir') [Ecological and geographical conditions of environmental management in the area of influence of the TRANS-Siberian railway (Western Siberia)]*. Novosibirsk: SGUPS [in Russian].

11. Popova, N. B. (2002). Environmental technology intensity and anthropogenic impact on the territories of regions and river basins of Western Siberia. *Problemy regional'noj ehkologii [Problems of Regional Ecology]*, *2*, 35–43 [in Russian].

12. Akimova, T. A., & Khaskin, V. V. (2000). *E'kologiya [Ecology]*. Moscow [in Russian].

13. Akimova, T. A., & Khaskin, V. V. (1994). *Osnovy ehkorazvitiya [The basics of eco-development]*. Moscow [in Russian].

14. Zemtsov, A. A., Mizerov, B. V., & Nikolaev, V. A. (1988). *Rel'ef Zapadno-Sibirskoj ravniny [The topography of the West Siberian plain]*. Novosibirsk: Nauka [in Russian].

15. Gvozdetskiy, N. A. (1973). *Fiziko-geograficheskoe rajonirovanie Tyumenskoj oblasti [Physico-geographical regionalization of the Tyumen region]*. Moscow: MGU [in Russian].

16. Belonenko, G. V., & Tusupbekov, Zh. A. (2014). Hydrological and climatic conditions of formation and the flow regime of the rivers of Western Siberia. *Nauchnye problemy transporta Sibiri i Dal'nego Vostoka [Scientific Transport Problems of Siberia and the Far East]*, *4*, 94–97 [in Russian].

17. Karnatsevich, I. V., Mezentseva, O. V., Tusupbekov, Zh. A., & Bikbulatova, G. G. (2007). *Vozobnovlyaemye resursy teplovlagoobespechennosti Zapadno-Sibirskoy ravniny i dinamika ikh kharakteristik [Renewable resources heat and moisture security of the West Siberian plain and the dynamics of their characteristics]*. Omsk: OmGAU [in Russian].

18. Belonenko, G. V. (1985). *Vodnobalansovye raschyoty neizuchennyh bassejnov malyh rek [Water balance calculations unexplored basins of small rivers]*. Omsk: OmSHI [in Russian].

19. Ryapolova, N. L. (2014). The maximum permissible anthropogenic load on the natural environment on the territory of Khanty-Mansi Autonomous Okrug (KHMAO-Yugra). *Nauchnye problemy transporta Sibiri i Dal'nego Vostoka [Scientific Transport Problems of Siberia and the Far East]*, *4*, 386–388 [in Russian].

20. Ryapolova, N. L. (2015). Assessment of environmental Technoelast natural systems of the Yamal-Nenets Autonomous district in connection with the economic development of the region. *Transport Urala [Transport of Ural]*, *1*, 111–114 [in Russian].

21. Belonenko, G. V., Tusupbekov, Zh. A., & Ryapolova, N. L. (2015). The formation and characteristics of moisture and heat landscape of the provinces of the West Siberian plain. *Problemy regional'noj ehkologii [Problems of Regional Ecology]*, *3*, 174–180 [in Russian].

22. Fedorov, M. M. (1993). Ecological potential in the problem of ecologization of nature management. *Izvestiya RGO [Izvestiya PRO]*, *6*, 64–68 [in Russian].

23. Aleksandrova, T. D. (1990). Normalization of anthropogenic-technogenic load on the landscape. State of the problem. Opportunities and constraints. *Izvestiya AN SSSR. Seriya geograficheskaya [Izvestiya AS USSR. Geographical series]*, *1*, 46–54 [in Russian].

24. Zharnikov, V. B., & Van, A. V. (2016). Geoecological bases of rational land use. *Vestnik SGUGiT [Vestnik SSUGT*], *4*(36), 176–183 [in Russian].

25. Nikolaeva, O. N. (2015). The use of cartographic models of natural resources at various stages of conducting environmental management. *Vestnik SGUGiT [Vestnik SSUGT]*, *3*(31), 79–86 [in Russian].

Received 06.06.2017

GEOSPATIAL ANALYSIS OF SOILS IN NORTHERN-WESTERN BARABA

Yuri V. Kravtsov
Novosibirsk State Pedagogical University, 630126, Russia, Novosibirsk, 28 Viluiskaya St., Dr. Sc., Professor, phone: (383)244-15-05, e-mail: kravtsov60@mail.ru

Konstantin S. Baikov
Siberian State University of Geosystems and Technologies, 630108, Russia, Novosibirsk, 10 Plakhotnogo St., Dr. Sc., Vice-rector for Scientific Activities, phone: (383)343-39-57; Central Siberian Botanical Garden SB RAS, 630090, Russia, Novosibirsk, 101 Zolotodolinskaya St., Chief Researcher, e-mail: kbaikov2017@mail.ru

Sergey V. Solovev
Institute of Soil Science and Agrochemistry SB RAS, 630090, Russia, Novosibirsk, 8/2 Akad. Lavrentyev Pr., Ph. D., Researcher, phone: (383)363-90-31; Novosibirsk State University of Economics and Management, 630005, Russia, Novosibirsk, 52/1 Kamenskaya, Asociate Professor, e-mail: solovyev87@mail.ru

Comparative analysis of mapping soils data in middle scale (1: 1000 000) is performed to understand its geospatial dynamics and correlations with geomorphologic data. Quantitative features for automorphic and hydromorphic mapping soil units in Northern and Western parts of Baraba lowland plain were calculated in according to its position in different geomorphologic regions. It was resulted that mesorelief has the main influence on soil units disposition in Northern and Western Baraba lowland plain: the most representative set of hydromorphic soils is placed in lowlands of investigated geospatial, against to soil spectra on the upper parts, where number of soil units is less and automorphic soils get the best bioclimatic conditions, so it is important to stable development a new agrobioindustrial clusters and inputs new technoligic approaches in this activity. In Southern direction general diversity os soils is increased, and no-salted automorphic soils from forest series are replaced by salty soils of forest steppe. Northern limits for solonets meadows and Southern limits for gray forest gley sois are along the contour line 0,7 of humidity coefficient for warm period of a year (from May to September), and chernozems leached are disposed some southern than the contour line 0,6 of humidity coefficient for warm period. In geospace Northern and Western parts of the Barabinsk low plain, the continuity and discretization of action for climatic and geomorphological factors are combined, that finds reflection in plasticity of hydromorphic soil compositions and mosaics of automorphic soil units.

Key words: agrobioindustry, geospatial analysis, geomorphology, soil mapping, Baraba lowland plain, automorphic soils, hydromorphic soils.

REFERENCES

1. Baikov, K. S., Kudryashova, S. Ya., Chichulin, A. V., Chumbaev, A. S., Solovev, S. V., Shergunova, N. A., Miller, G. F., & Bezborodova, A. N. (2014). Sozdanie regionalnykh bankov dannykh i spravochno-analiticheskikh sistem novogo pokolenia dlya ozenki pochvennykh I

rastitelnykh resursov Zapadnoi Sibiri. In *Pochvennye i zemelnye resursy: sostoyanie, ocenka, ispolzovanie [Soil and land resources: status, evaluation, using]*. Moscow [in Russian].

2. Karpik, A. P. (2004). *Metodologicheskie i tekhnologicheskie osnovy geoinformatsionnogo obespecheniya territoriy [Methodological and technological bases of geoinformation support areas]*. Novosibirsk: SSGA [in Russian].

3. Karpik, A. P., Osipov, A. G., & Murzintsev, P. P. (2010). *Upravlenie territoriei v geoinformatsionnom diskurse [Territory management in geoinformation discourse]*. Novosibirsk: SSGA [in Russian].

4. Nikolaeva, O. N. (2016). On the design of the thematic content of the system of digital cartographic models of the natural resources of the region. *Geodeziya i kartografiya [Geodesy and Cartography]*, *7*, 25–30 [in Russian].

5. Kochurov, B. I. (1999). *Geoekologiya: ekodiagnostika i ekologo-khozyaystvennyy balans territorii [Geoecology: ekodiagnostika and ecological-economic balance of the territory]*. Smolensk: SGU [in Russian].

6. Karpova, L. A. Mapping evaluation indicators environmental and economic balance using GIS technology *Vestnik SGUGIT [Vestnik SUGGT]*, *4*(36), 122–135 [in Russian].

7. Dobrotvorskaya, N. I., Dubrovskiy, A. V., Kapustyanchik, S. Ju., Malygina, O. I., & Trotsenko, E. S. (2014). Elementy struktury geoinformacionnogo obespechenija agroekologicheskogo adaptivno-landshaftnogo zemlepolzovaniya *Izvestiya vuzov. Geodeziya i aerofotosemka. [Izvestia Vuzov. Geodesy and Aerophotography]*, *S/4*, 146–153 [in Russian].

8. Dobrotvorskaya, N. I. (2016) Informacionnoe obespechenie proektirovanija adaptivno-landshaftnych sistem zemledeliya *Izvestiya Orenburgskogo gosudarstvennogo agrarnogo universiteta [Izvestia of Orenburg State Agricultural University]*, *1*(57), 151–154 [in Russian].

9. Kaverin, D. A., Shakhtarova, O. V., Pastukhov, A. V., Mazhitova, G. G., & Lapteva, E. M. (2012). Sostavlenie krupnomasshtabnykh pochvennykh kart kluchevykh uchastkov v tundre i lesotundre severo-vostoka evropeiskoi Rossii. *Geographia i prirodnye resursy [Geography and Natural Resources]*, *3*, 140–146 [in Russian].

10. Martynov, A. V. (2014). Opyt ptimenenia GIS v sozdanii pochvennykh kart poimennykh uchastkov v srednem techenii Amura. *Geographia i prirodnye resursy [Geography and Natural Resources]*, *2*, 161–166.

11. Karunaratne, S. B., Bishop, T. F. A., Baldock, J. A., & Odeh, I. O. A. (2014). Catchment scale mapping of measureable soil organic carbon fractions. *Geoderma*, *219–220*, 14–23.

12. *Klassifikacia i diagnostica pochv SSSR [Classification and diagnostics of soils from URSS]* (1977) Moscow: Kolos [in Russian]

13. Baikov, K. S., Solovev, S. V., Shergunova, N. A., Poshivaylo, Ya. G., & Chernenko, Yu. V. (2017). Zakonomernosti razmeshheniya pochv na kontakte yuzhnoi taigi i lesostepi Zapadnoi Sibiri. *Geografiya i prirodnye resursy [Geography and Natural Resources]*, *1*, 134–142 [in Russian].

14. *Edinyi gosudarstvennyi reestr pochvennykh resursov Rossii. Versia 1.0 Kollectivnaya monographia [Unified state register of soil resources of Russia. Version 1.0. Collective monograph]*. (2014). Moscow [in Russian].

15. *Pochvy Novosibirskoj oblasti: Karta. Masshtab 1 : 1 000 000 [Soils of Novosibirsk region: Map. Scale 1: 1 000 000]*. (2007). Novosibirsk [in Russian].

16. *Prirodnoe raionirovanie i sovremennoe sostoyanie pochv Novosibirskoi oblasti. Atlas [Natural zoning and the current state of soils in Novosibirsk region. Atlas]*. (2010). Novosibirsk [in Russian].

17. *Pochvenno-klimaticheskiy atlas Novosibirskoj oblasti [Soil and climatic atlas for Novosibirsk Region]*. (1978). Novosibirsk: Nauka [in Russian].

18. Volobuev, V. R. (1973). *Sistema pochv mira [World soil system]*. Baku: Elm [in Russian].

Received 04.07.2017