Rosreestr
The Federal Service for State Registration, Cadastre and Cartography

Geospatial Information Management in the Russian Federation

COUNTRY REPORT TO THE UNITED NATIONS COMMITTEE OF EXPERTS ON GLOBAL GEOSPATIAL INFORMATION MANAGEMENT

Federal Service for State Registration, Cadastre and Cartography

Center for Geodesy, Cartography and Spatial Data Infrastructure

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Table of content

Geospatial Information Management in the Russian Federation

The area of the Russian Federation is 17.1 million square kilometres; its territory lies in 11 time zones. The length of the Russia's land borders is 22,125,3 km.

Background

One of the earliest reliable maps of Russia, the "Big Drawing", is dated 1598. In the 17th century, the period of Peter the Great, a "General regulation" was developed, defining the state centralization of geodetic activities, and the system of geodesy training emerged.

In 1745, the Geographical Department of the Academy of Sciences published the Atlas of Russia, containing a General Map of the Russian Empire on a scale of 1:8,400,000, 13 maps of European regions of Russia on a scale of 1:1,470,000 and 6 maps of Siberia on a scale of 1:3,738,000.

During Paul I, at the end of the 18th century, mapping transferred to the military department, while Alexander I, at the beginning of the 19th century, established a Corps of Military Topographers.

Russian geodesy and cartography demonstrated significant success after the Pulkovo Observatory was founded in 1839. The 19th century was a time of important

discoveries. Under the guidance of the outstanding scientist Vasily Struve[1] a degree measurement of the meridian arc was carried out and valuable data were obtained to determine the shape and size of the Earth.
During the years of the USSR, a highly precise geodetic network covering the entire territory of the country was created and the most detailed topographic maps were published.

Since the 90's of the 20th century the rapid development of new technologies began, many of which became applicable to the cartographic and geodetic industry. This period marked the beginning of a new stage of technological development in the field of geodesy and cartography, connected with the transition to autonomous satellite methods of coordinate determination, digital mapping methods and introduction of geoinformation systems and technologies.

From 1992 to 2008, the Federal Service of Geodesy and Cartography performed functions in the field of geospatial information management.
Former branches of the FSGC became enterprises and engaged in production and commercial activities independently. In addition, private companies involved in geodesic and cartographic work occurred. Competition between them, as well as increased consumer demand, naturally led to the emergence and development of the cartographic and geodesic market.

Along with the traditional types of cartographic and geodesic works in the 90's, the industry began to implement new activities, including creation and updating of digital maps and ground plans, conversion of analogue cartographic materials into digital form, creation and maintenance of geographic information systems of federal and regional levels.
Due to the adoption of the Concept of transition of topographic and geodesic production to autonomous coordinate determination methods in the mid-90s, a necessity to create a new structure of the state geodetic network increased, which included: the Fundamental Astronomical-Geodetic Network (FAGN),

[1] Vasiliy Struve (Friedrich Georg Wilhelm Struve) was born in 1793 in Danish Áltona (currently in Germany) and accepted Russian citizenship in 1842. Struve became the first director of the Pulkovo Observatory (St. Petersburg) and was one of the members-founders of the Russian Geographic Society.

the High-Precision Geodetic Network (HPGN) and the Satellite-Based Geodetic Networks of the 1st category (SBGN-1).

The most important stage in the enhancement of the reference framework was introduction of the State Geodetic Reference Framework (RF-95) on the territory of the Russian Federation in 2002. The introduction of this reference framework became possible because of the completion of a joint adjustment of the Astronomical Geodetic Network (AGN), Doppler Geodetic Network (DGN) and Space Geodetic Network (SGN). A new reference framework was obtained, which is distributed with equal accuracy throughout the Russian Federation and is much more precise than the previously existing reference framework of 1942.

In the early 2000s, in addition to the base map improvement, the state altitude base of the country was also modernized. Implementation of the Program of modernization of the 1st and 2nd classes levelling network of the Russian Federation in 2001–2010 allowed to ensure the proper level of the state system of heights and to combine the levelling networks of 1st and 2nd classes with satellite geodetic networks FAGN and HPGN to build a unified system of normal heights and kinematic height base on the territory of Russia, as well as to provide economy and science with reliable and up-to-date information on vertical Earth's ground movement.
In this very period, highly precise gravimetric determinations were made at the FAGN and HPGN points, which became part of the state fundamental and gravimetric networks of the 1st class. The development of the state gravimetric network also continued.
Digital mapping of territories and the creation of geoinformation systems (GIS) have been widely developed. The federal program on the development of Government Bodies GIS began in the early 2000s.

Governance

Since 2008 after the merge of three state bodies, the Federal Service for State Registration, Cadastre and Cartography (Rosreestr) has become responsible for the development of geospatial information management.
Rosreestr performs functions in the spheres of state cadastral registration of real property, registration of rights to real property, land monitoring and control of its use, geodesy, cartography and the development of spatial data infrastructure (SDI).

Rosreestr also carries out tasks of a federal level in the spheres of state cadastral valuation, supervision over the activities of self-regulated organizations of cadastral engineers, self-regulated organizations of appraisers and insolvency receivers.
Since 2020, Rosreestr is directly subordinated to the Government of the Russian Federation and carries out legal regulation for its fields of responsibility.

Rosreestr supervises two federal state budgetary institutions: the Federal Cadastral Chamber (FCC) and the Federal Scientific and Technical Centre of Geodesy, Cartography and Spatial Data Infrastructure (Centre of Geodesy, Cartography and SDI).
The FCC performs the functions in the spheres of state registration of rights to real property and transactions, cadastral registration of real property and cadastral valuation, as well as the maintenance of the Unified State Register of Real Property, which includes inputting information on the boundaries of areas with special conditions of use, objects of cultural heritage, borders of subjects, municipal formations, settlements and other objects.
The main activities of the Centre of Geodesy, Cartography and SDI are:

- → provision of materials and data from the Federal Spatial Data Fund (FSDF);
- → maintenance of the FSDF, including the metadata base;
- → creation and maintenance of the State Catalogue of Geographical Names;
- → determination of the parameters of the figure and gravity field of Earth;
- → maintenance of the portal of accurate “fast” ephemerides of the GLONASS orbit group based on the analysis and processing of the measurements taken at the constantly operating points of the Fundamental Astronomical-Geodetic Network (FAGN);
- → monitoring the parameters of the points of the state geodetic network, the state levelling network and the state gravimetric network;
- → drafting normative and technical documents and standards in the field of geodetic, cartographic activities and spatial data infrastructure, setting out technical requirements, standards and rules for geodetic works;
- → performing the functions of the metrological service in the field of geodesy, cartography and spatial data infrastructure of the Russian Federation;
- → maintenance of a Unified Digital Basemap (UDB);
- → development and creation of geoinformation systems;
- → publication of a monthly industry scientific journal “Geodesy and Cartography”.

In 2012, JSC "Roskartography", which consists of 32 subsidiary companies was established in order to preserve, develop and ensure the effective use of scientific and production potential of unitary enterprises involved in geodesy and cartography, and to meet the needs of the Russian Federation in cartographic, navigation and geodesic products.
By 2024, subordinate organizations of Rosreestr, JSC "Roscartography" and JSC "Rostechinventory – Federal Bureau of Technical Inventory" will be merged into the public law company "ROSCADASTRE" – a single full-cycle enterprise that is being established to increase the efficiency of activities in the field of real property and spatial data in the Russian Federation.

Legal framework

Russia has a modern legal framework in the field of geodesy and cartography, land administration, state registration of real property and rights to it. The main legislative acts in these spheres are:

- → Land Code of the Russian Federation of 25.10.2001 No. 136-FZ;
- → Federal Law of 30.12.2015 No. 431-FZ "On Geodesy, Cartography and Spatial Data";
- → Federal Law of 18.12.1997 No. 152-FZ "On the Names of Geographical Objects";
- → Federal Law of 18.06.2001 No. 78-FZ "On Land Management";
- → Federal Law of 24.07.2007 No. 221-FZ "On Surveying (cadastral) Activity";
- → Federal Law of 13.07.2015 No. 218-FZ "On State Real Property Registration".

These laws are supported by more than 300 by-laws (Decrees of the Government of the Russian Federation, departmental orders and regulations).
The list of regulatory legal acts in the spheres of geodesy and cartography is available on the official website of Rosreestr.

Rosreestr has developed a draft Federal Law «On Amendments to the Federal Law «On Geodesy, Cartography and Spatial Data and on Amendments to Certain Legislative Acts of the Russian Federation» and some legislative acts of the Russian Federation aiming to improve the regulation of relations emerging during geodesic and cartographic activities, including the use of domestic geoinformation technologies, systems of spatial data portals and the state information system for maintaining a Unified Digital Basemap.

The draft law proposes to identify a federal executive body authorized to carry out legal regulation in the field of domestic geoinformation technologies use (hereinafter the competent body) and empower such body to establish requirements for geoinformation system software and developers of such systems used in the state authorities of the Russian Federation and local self-government bodies, as well as to require the governmental sector to use domestic software for geoinformation systems.

The draft law also obliges legal entities performing geodetic activities and using the results of such activities to submit information on spatial data (spatial metadata) (or) materials obtained as a result of geodetic and cartographic work to the federal fund of spatial data, which will enable other interested parties to obtain information on spatial data and materials that have already been collected.

Other amendments improve activities in the field of geodesy and cartography and increase the efficiency of circulation of spatial data. These amendments, in particular, suggest:

- → to add to the list of works performed in mapping activities the remote sensing of Earth, and to give the authorized body the authority to establish requirements for its performance;
- → to empower the competent body to approve the procedure for examination, maintenance, liquidation and restoration of the state geodetic network points, state levelling network, and state gravimetric network points;
- → to supplement Federal Law No. 431-FZ with provisions regulating the requirements to the creation, operation, functioning and development of the Federal Geodetic Stations Network (FGSN), differential geodetic stations included in the FGSN, as well as the order of functioning of the FGSN state information system;
- → to empower the Government of the Russian Federation to approve the Regulation on confirmation of reliability of spatial data included in state spatial data funds.

Geodetic support system

The system of geodetic support of the Russian Federation is a general set of fundamental parameters of the figure of Earth and the external terrestrial gravitational field, implemented on the territory of the Russian Federation through the state coordinate basis and the structure of state networks implemented on the

territory of the Russian Federation by the following structure of state geodetic networks:

- → Fundamental Astronomical-Geodetic Network, FAGN (54 points);
- → High-Precision Geodetic Network, HPGN (387 points);
- → Satellite-Based Geodetic Network of the 1st category, SBGN-1 (5856 points);
- → Astronomical-Geodetic Network of the 1st and 2nd classes;
- → Extensive Geodetic Network of the 3rd and 4th classes.

In accordance with the Decree of the Government of the Russian Federation dated 11.24.2016 No. 1240, since January 1, 2021 the following state coordinates and heights framework have been operating in Russia:

- → Geodetic Reference Framework of 2011 (GRF-2011), established and distributed through the state geodetic network (it is used in the performance of geodetic and cartographic works);
- → Global Geocentric Coordinate System "Earth Parameters of 1990" (EP-90.11), established and distributed by the satellite geodetic network and the state geodetic network (it is used for geodetic support of orbital flights, navigation solutions, etc.);
- → Baltic System of Heights of 1977 the normal heights of which are reckoned from the zero of the Kronstadt tidal gauge (it is used as a state system of heights).

The state gravimetric system is defined by the results of gravity measurements at the points of the state gravimetric network, made in gravimetric system of 1971, the starting points of which are located in Moscow and Novosibirsk.

The basis of GRF-2011 reference framework is the state satellite-based geodetic networks used to derive the parameters of this system.

The structure of the state geodetic network, which practically implements the GRF-2011 reference framework and makes it available for users, also includes networks of triangulation, polygonometry and trilateration networks of 1st-4th classes (approximately 283 thousand points) equated with the reliance on the FAGN, HPGN and SBGN-1 points. This makes it possible to use geodetic, topographic and cartographic materials created earlier on the basis of traditional methods and technologies in the GRF-2011 reference framework.

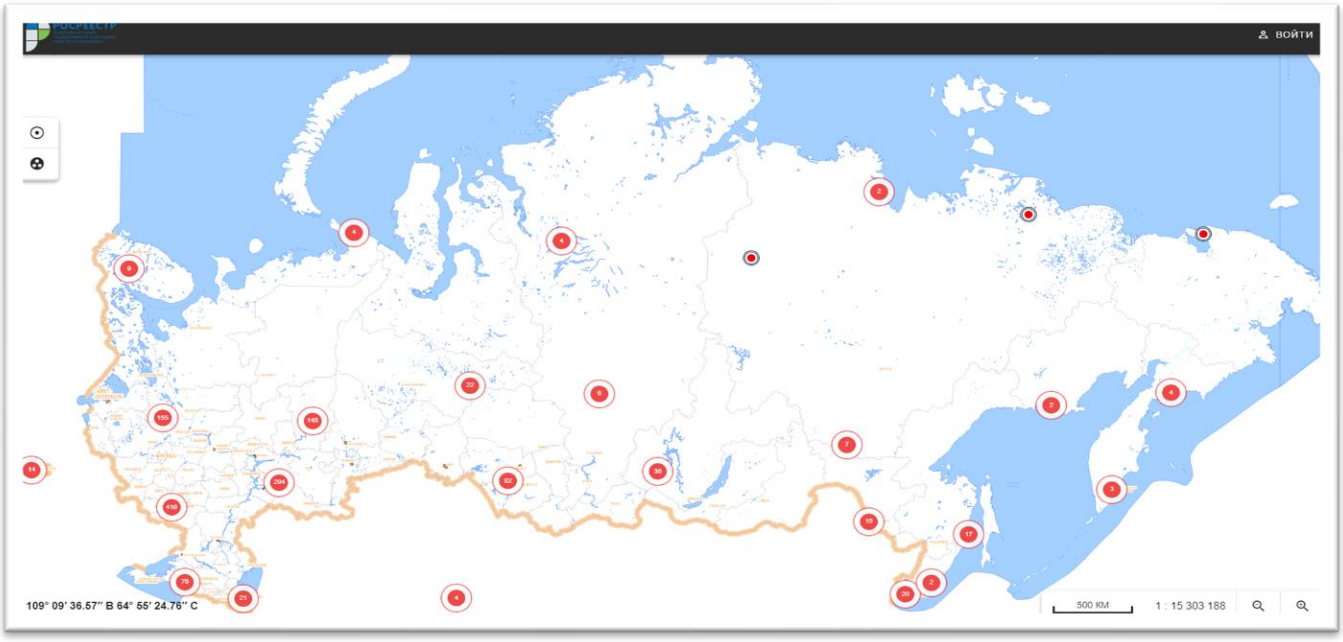
GRF-2011 reference framework is one time more precise than the reference framework of 1942 and two times more precise than the reference framework of 1995.

By 2021, in accordance with the FAGN and HPGN construction programs, the

development of the state geodetic network included creation of 231 FAGN, HPGN and SBGN-1 points, which will be continued further.

To ensure the development of methods of construction of a high-precision geocentric reference framework and its orientation, to maintain the unity of measurements, a service of precise ephemerides of GLONASS satellites was created in the “Centre of Geodesy, Cartography and SDI”.

The Rosreestr’s Centre of precise ephemerides collects and accumulates satellite information, coordinates the work of the FAGN points of Rosreestr, the relevant work of Russian Academy of Sciences, Roscosmos, Rosstandart and other organizations, and ensures processing of measurements and calculation of the datum of the GLONASS Earth satellites, which are conveyed to consumers. The outcomes of the Center’s work are publicly available on the website: https://rgs-centre.ru/.



In accordance with the general concept of the development of the geodetic support system of the territory of Russia, a regulatory and technical policy to regulate the creation of permanent differential geodetic stations is being carried out. Since 2019, Rosreestr has been working on the creation of the federal network of geodetic stations, which is designed to unify information about the stations of all operators, to promote GRF-2011 and to improve the quality of services provided.

In 2022, Rosreestr created a Complex of Hardware-Software means of the Federal Geodetic Stations Network (HSC FGSN). It is an information system designed to collect, process and provide information about differential geodetic stations included in the FGSN.

Fundamental Astronomical Geodetic Network (FAGN) in Russia is the most precise network for the distribution of a unified reference framework of spatial coordinates and time throughout the country (to ensure the uniformity of measurements) and is used as the basis for all legally significant geodetic definitions.

The key users of geodetic station networks are surveyors and cadastral engineers that use satellite equipment for precise positioning, as well as owners of unmanned vehicles (aviation, marine, ground), etc.

Simultaneously with the FAGN points, other networks of geodetic stations have been actively developing for more than 10 years, rendering services for the provision of differential corrections. Currently, there are more than 4000 stations operating in the Russian Federation, which have already been created both at the expense of the federal budget and at the expense of individuals and legal entities.

In order to supplement the FAGN network and significantly increase the density of differential stations, as part of the creation of the FGSN all existing correctly installed and functioning geodetic stations on the territory of the Russian Federation are in the process of connecting to a single network through an integration centre, which is a hardware-software complex that is going to develop into a state information system in the long term.

The coverage area of the FGSN will constantly expand, the number of users of such network will be unlimited.

Geodynamic researches

The repeated highly-precise geodetic measurements help to determine quantity characteristics of the Earth crust movements in plan and height, to identify both “secular” movements of vast regions and deformation predictors of earthquakes and volcanic eruptions.

Since the early 1970s, enterprises of the State Cartographic and Geodesic Service performed geodynamic researches with traditional methods of highly-precise geodetic determinations on 50 geodynamic polygons (GDP), located in areas of high seismicity of the territory of Russia.

Federal State Budgetary Institution “Centre of Geodesy, Cartography and SDI” conducts geodynamic researches in the regions of high seismicity and volcanic activity: in the Far East (Kuril Islands, Kamchatka peninsula, island Sakhalin), Baikal Rift Zone and North Caucasus. Since 2019, work has resumed at the Crimean Geodynamic

Polygon. Measurements are carried out by satellite methods, as well as by highly-precise relevelling. Modern satellite technologies allow continuous monitoring of deformation processes with the provision of registration of deformations of the Earth crust at an accuracy level from ± 2-3 mm to ± 1 cm depending on the distance between points. Special geodetic networks with improved precision relying on the points of FAGN, HPGN and SBGN-1 have been developed in accordance with the scheme of a new state geodetic network development.

In order to work out new technologies for studying deformation processes and possible modelling of earthquake preparation processes, the works on the abovementioned geodynamic polygons modernization is carried out, which includes creation of permanently operating points with satellite geodetic equipment on the basis of points of geodynamic polygons. Since 2021, Rosreestr has launched the new scientific research in the field of geodynamics.

Names of geographical objects

The Federal Service for State Registration, Cadastre and Cartography is responsible for the development of state policy and legal regulation in the area of names of geographical objects.

The Federal Law of 18.12.1997 No. 152-FZ "On the names of geographical objects" (hereinafter – the Federal Law) establishes the legal basis for the activities in the field of naming and renaming geographical objects as well as normalization, use, registration, accounting and preservation of the names of geographical objects as part of the historical and cultural heritage of the nations of the Russian Federation.

Naming and renaming of geographical objects is the responsibility of the Government of the Russian Federation.

Proposals on the attribution of names to geographical objects or on the renaming of objects may be submitted by authorities of the Russian Federation, regional authorities,

local government bodies, non-governmental organisations, legal entities and citizens of the Russian Federation.

Since the establishment of Rosreestr, more than 400 government acts on naming and renaming of geographical objects have been issued.

In addition, in accordance with the Order of the President of the Russian Federation No. 681 of 28.11.2018 "On naming certain geographical objects after persons of special merit to the Fatherland", since 2019 more than 50 airports in the Russian Federation have been named after people who have special merit based on the results of public discussions.

In accordance with article 10 of the Federal Law, the existing names of geographical objects and the names being assigned to them shall be registered and recorded. The State Catalogue of Geographical Names (hereinafter the State Catalogue) is designed in order to provide the consistent and sustainable use of the names of geographical objects in the Russian Federation and to ensure the preservation of these names.

Today, the State Catalogue contains information on the names of about 800,000 geographic objects, including formerly existing names.

The "Centre of Geodesy, Cartography and SDI" maintains the State Catalogue.

The State Catalogue comprises information on the history of establishment and change of names, sources of names, administrative and geographic references, and location of an object.

Information of the State Catalogue is published on the operator's official website and is available upon request, free of charge.

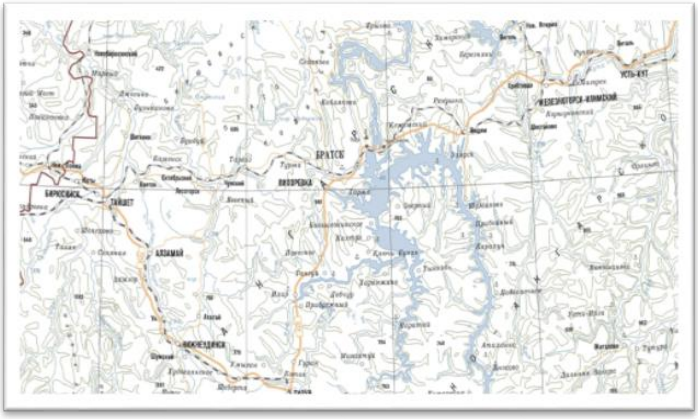
In addition, Rosreestr jointly with the agencies of the CIS countries[2] update a bulletin "Changes of geographical names of the CIS member states".

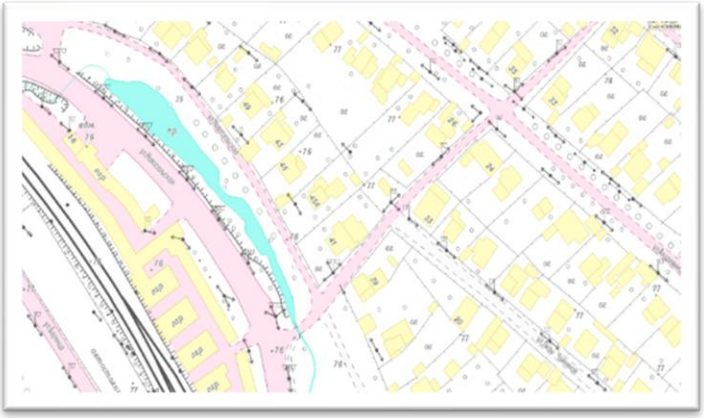
Unified Digital Basemap

The Unified Digital Basemap (UDB) – is a systematized set of spatial data on the territory of the Russian Federation, created in the form of digital topographic maps (plans) and digital orthophotoplans (DOPP) of various scales. The "Centre of Geodesy, Cartography and SDI" has the authority to create, update and ensure the monitoring of the relevance of the UDB, as well as its data ownership.

[2] Commonwealth of Independent States

By now, the whole territory of Russia is covered by UDB in the form of digital topographic maps at different scales. Maps have been compiled at a scale of 1:200 000 for the southern part of the country and at a scale of 1:25 000 for the territories with a high population density. There are also more detailed maps for a number of cities and regions: for example, digital topographic plans and orthophotoplans at a scale of 1:2000 have been compiled for Nizhny Novgorod and Perm.





The main advantage of the UDB over the original topographic maps and plans is the availability of obtaining the data in widespread formats of the Open Geospatial Consortium (OGC), standardized composition and unified graphic design.

The accuracy and completeness of UDB allows consumers to use it in various geoinformation systems and create any thematic layers and services based on it, being confident in the reliability of the base map made according to a single standard.

In 2021, the creation of the State Information System for the aintainance of the UDB (SIS UDB) was completed.

SIS UDB is a system that allows providing consumers with a basic legally significant state cartographic basis – the UDB, in the form of cartographic services according to common OGC standards (in addition to vector and bitmap exchange formats, as well as image files), and also ensures continuous updating of the UDB data.

Federal Spatial Data Fund

Federal Spatial Data Fund (FSDF) includes geodetic, cartographic, topographic, hydrographic, aerospace and gravimetric materials of national importance.

The holder of the FSDF is the Federal State Budgetary Institution "Centre for Geodesy, Cartography and SDI", which delivers data services.

The FSDF contains approximately 87 million units of storage of spatial data and materials.

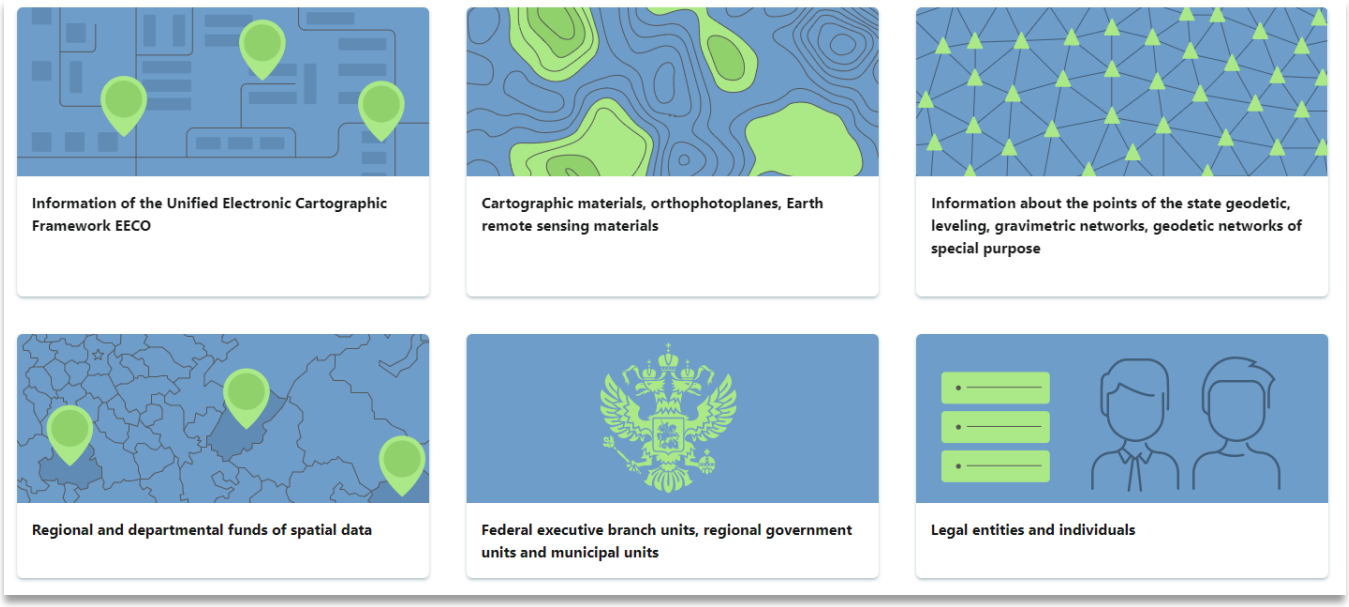
In 2022, an information system for maintaining FSDF (IS FSDF) was created. The system provides automation of the processes of maintaining FSDF and digital materials storage and reduces the time of technological procedures for placing materials to the fund and issuing them to consumers.

Objectives of creating the information system are:

1. Automation of the process of providing a wide range of applicants with up-to-date cartographic and geodetic data, including the materials of the UDB through the integration of the IS FSDF with the SIS FSDP and SIS UDB.
2. Automation of the FSDF maintenance processes.
3. Creation of tools for geo-analytics.

Federal Spatial Data Portal

In 2021, the State Information System Federal Spatial Data Portal (SIS FSDP) was set in operation.

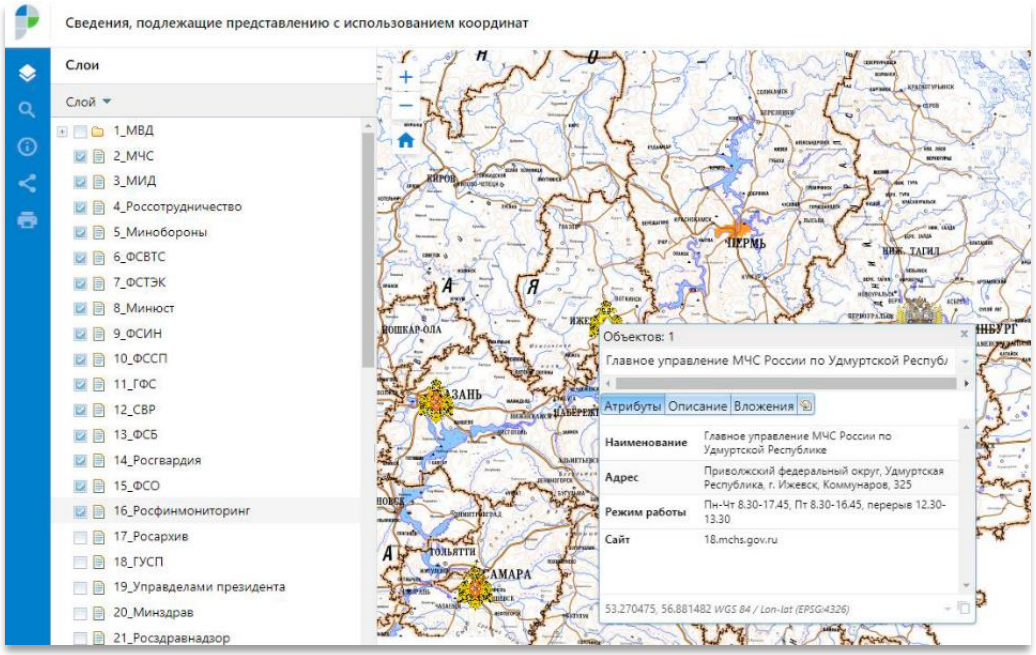


This electronic storefront allows providing comprehensive information on the accessibility of the cartographic and geodesic materials on the territory of the Russian

Federation with the possibility to obtain them promptly. SIS FSDP is a tool for ensuring the exchange of spatial data, providing authorities and local self-government bodies, individuals and legal entities with materials contained in the FSDF, data contained in the UDB.

The main functions on the FSDP are:

- → receiving applications for provision of spatial data and materials contained in the FSDF and UDB, and spatial metadata;
- → processing of applications (automated preparation of draft documents, cost calculation, signing of documents with an enhanced qualified electronic signature);
- → provision of spatial data and materials contained in the FSDF and UDB, and spatial metadata;
- → publication of spatial metadata contained in the state spatial data funds, including FSDF;
- → transfer of spatial metadata of geodetic and cartographic activities materials from regional and departmental spatial data funds and legal entities to the FSDF, as well as their publication on the FSDP;
- → inclusion, storage and provision of information to be provided using location data;
- → visualization of data, working with user web maps;
- → preparation of various databased analytical reports.



Selection of information of various authorities

The Federal Spatial Data Portal (FSDP) brings the following advantages for all categories of consumers (public and local self-government authorities, individuals and legal entities):

- → reduction of actual time of provision of spatial data and materials;
- → optimization of the procedure for providing spatial data and materials contained in the FSDF and UDB;
- → systematization and accessibility of spatial data and materials contained in all state funds on the territory of the Russian Federation;
- → a web-interface for the work with spatial data: possibility to download, connect and analyse user geodata, UDB data and FSDF materials (with no need to purchase and install geo-information software);
- → raising the level of awareness of all categories of applicants about the spatial data and materials contained in the UDB and FSDF and information to be provided using location data.

National Spatial Data System

In the context of digitalization, the spatial data provision services and the creation of services based on them are of paramount importance for creating new opportunities for the dynamic development of the country.

The definition “Spatial data” broadly refers to all data on land and real property, including geospatial data, cadastral data, information on rights, data on cadastral value, in other words, to all data contained in the Unified State Register of Real Property and other informational systems (resources).

In 2021, the state program “National Spatial Data System” (NSDS) was approved by the Russian government.

The objectives of the NSDS creation are:

- → Creation and implementation of digital domestic geospatial support integrated with municipal and regional informational systems in the territories of 85 regions of the Russian Federation by the end of 2030;
- → Improving the quality of public services for the implementation of state cadastral registration and (or) state registration of property rights, including availability of 95 percent of public services in electronic form by the end of 2030;
- → Achievement of "digital maturity" in the field of state cadastral registration of real property and state registration of rights to real property while

establishing 100 % of spatial data infrastructure in the Russian Federation by the end of 2030;

→ Ensuring the completeness and quality of 95 percent of information in the Unified State Register of Real Property by the end of 2030.

The programme's goal "Creation and implementation of digital domestic geospatial support integrated with municipal and regional informational systems in the territories of 85 regions of the Russian Federation by the end of 2030" includes the task to create a single digital spatial data platform for all Russian regions.

This task in accordance with the Decree of the Government of the Russian Federation dated 06.07.2022 No. 1040 is being achieved through creation of a federal state information system "Unified Digital Platform "National Spatial Data System" (UDP "NSDS") by 2022-2023, which will perform the following functions:

→ search, collection, creation, storage, processing, provision and dissemination of spatial data contained by the UDP "NSDS";

→ maintaining state and other information resources necessary for the functioning of the NSDS;

→ information interaction, including information exchange between the system and other information systems (resources);

→ providing users with spatial data of UDP "NSPD" also through the spatial data portal "National Spatial Data System", which is part of the state information system UDP "NSDS ";

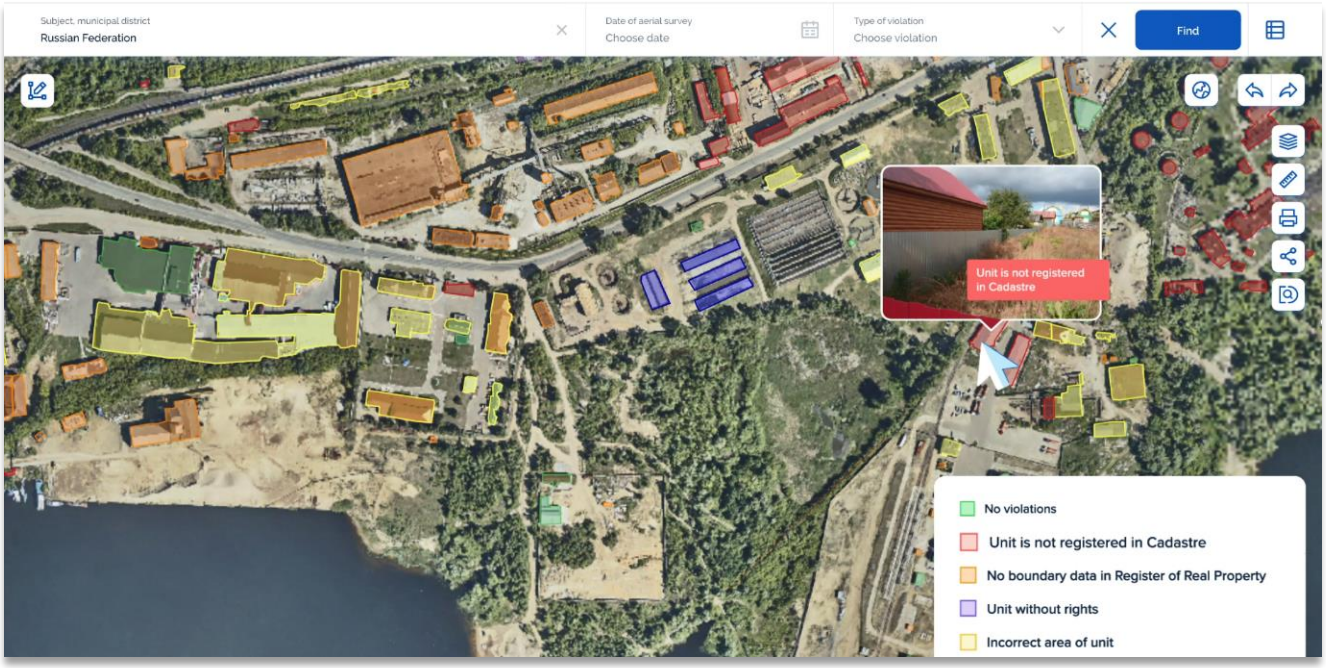
→ provision of state and municipal services related to the use of spatial data through information interaction with a Single portal of state and Municipal services (functions);

→ functioning of the electronic services of the NSDS Portal related to the use of spatial data, as well as programs for computers and databases that provide spatial data analysis, reporting and analytics.

Thus, spatial data from all federal, regional, municipal and other information systems (resources) will be combined within the framework of the SIS UDP "NSDS", which will allow to create a digital multi-scale map of the Russian Federation. It is also planned to implement a set of electronic services for the state, citizens, business, and professional communities on the basis of the SIS UDP "NSDS".

The services will be focused on solving life situations related to land and real property ("Smart Cadastre", "Land Simply", "Land for construction", "Land for tourism"), as well

as for developers ("Urban development online", "Permissions for construction", "Integrated development of the territory", "Individual housing construction").



Digital service "Smart Cadastre" classifies real property objects

A number of electronic services have already been tested in model regions in 2021 during the experiment on creation of a single information resource about land and real estate. In 2022, the “Smart Cadastre” service became a winner of the all-Russian cross-industry award in the field of big data “Data Fusion Awards” in the nomination "Data Fusion in the public sector. Nationwide”.

"Smart cadastre" allows to identify and recognise buildings and land plots, as well as deforestation, violations in the use of land, with the use of artificial intelligence.

Implementation of the state program and the creation of the SIS UDP “NSDS” will accomplish the following tasks:

- → to create a single open environment for the development and use of geodata;
- → to provide access to up-to-date spatial data in real time;
- → to ensure the digital transformation of state and municipal services in the field of land and real estate;
- → to reduce the time of cadastral registration and registration of rights to 1 day;
- → to increase budget revenues by identifying unregistered real property objects.

In addition to the development of a national spatial data system, Rosreestr, together with partner institutions from the Interstate Council for Geodesy, Cartography and Remote Sensing of Earth of the CIS[3] Member States are working on the creation of a joint spatial data infrastructure portal.

Management of Cadastral and Property Rights Data

In 2017, two large-scale information systems – the State Real Property Cadastre and the Unified State Register of Rights for Real Property and Related Transactions – were united into the Unified State Register of Real Property.

This speeded up registration procedures, improved business processes, and allowed introducing the extraterritorial provision of services (registration, provision of information).

Until the end of 2008, the systems of registration of real property units and registration of rights for them were developing separately. The corresponding information resources were based on different sources and were managed by different institutions.

This way of registration and record-keeping activities was not efficient: the information about real property objects duplicated in the registry of rights and the real property cadastre.

The strategy of combining the rights register and the real property cadastre included:

- → maximum integration of real property registration and rights registration systems, including databases of the real property cadastre and register of rights;
- → constant harmonization and verification of data of the real property cadastre and register of rights;
- → consolidating regional databases into a single information resource at the federal level;
- → developing electronic services (since June 1, 2015 the possibility of a full cycle of state registration of rights for real property without the use of paper and the need for a personal visit of the applicant has been implemented; electronic services of Rosreestr are available to all applicants on the website of Rosreestr and the Public Services Portal);
- → transition to a unified registration and record-keeping procedure for real property, including the registration of property rights.

[3] The Commonwealth of Independent States

In 2020, Rosreestr completed the transition to the Federal State System of Maintaining the Unified State Register of Real Property (USRRP).

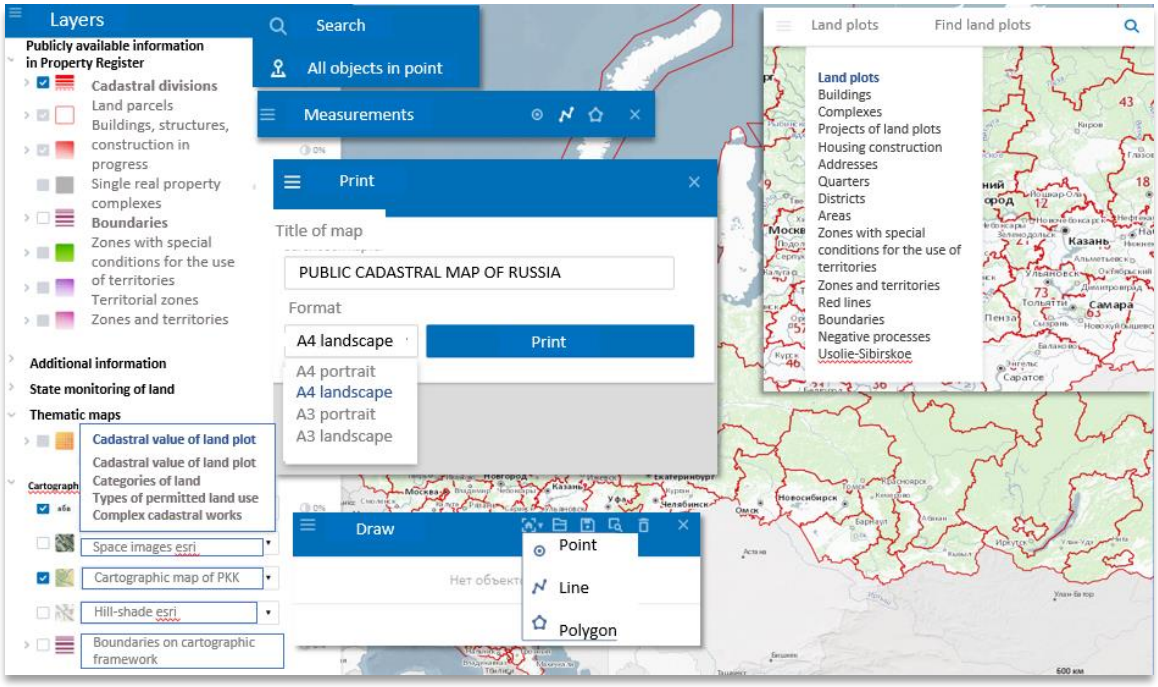
The USRRP consists of:

1) register of real property;
2) register of rights, restrictions of rights and encumbrances on real property;
3) register of information on the boundaries of zones with special conditions of use of territories, territorial zones, cultural heritage objects territories, protected natural territories, special economic zones, hunting lands, areas of advanced socio-economic development, regional development zones in the Russian Federation, gambling zones, forestry and forest park areas, data on state borders of the Russian Federation, borders between regions of the Russian Federation, borders of municipalities and settlements, coastlines (boundaries of water objects), etc.

The quality of the USRRP data is ensured by constant data harmonization and verification (actualization, correction of errors).

Public Cadastral Map

The public cadastral map (https://pkk.rosreestr.ru/), an open information resource of Rosreestr, has been in operation since 2010.



Data categories on the Public Cadastral Map

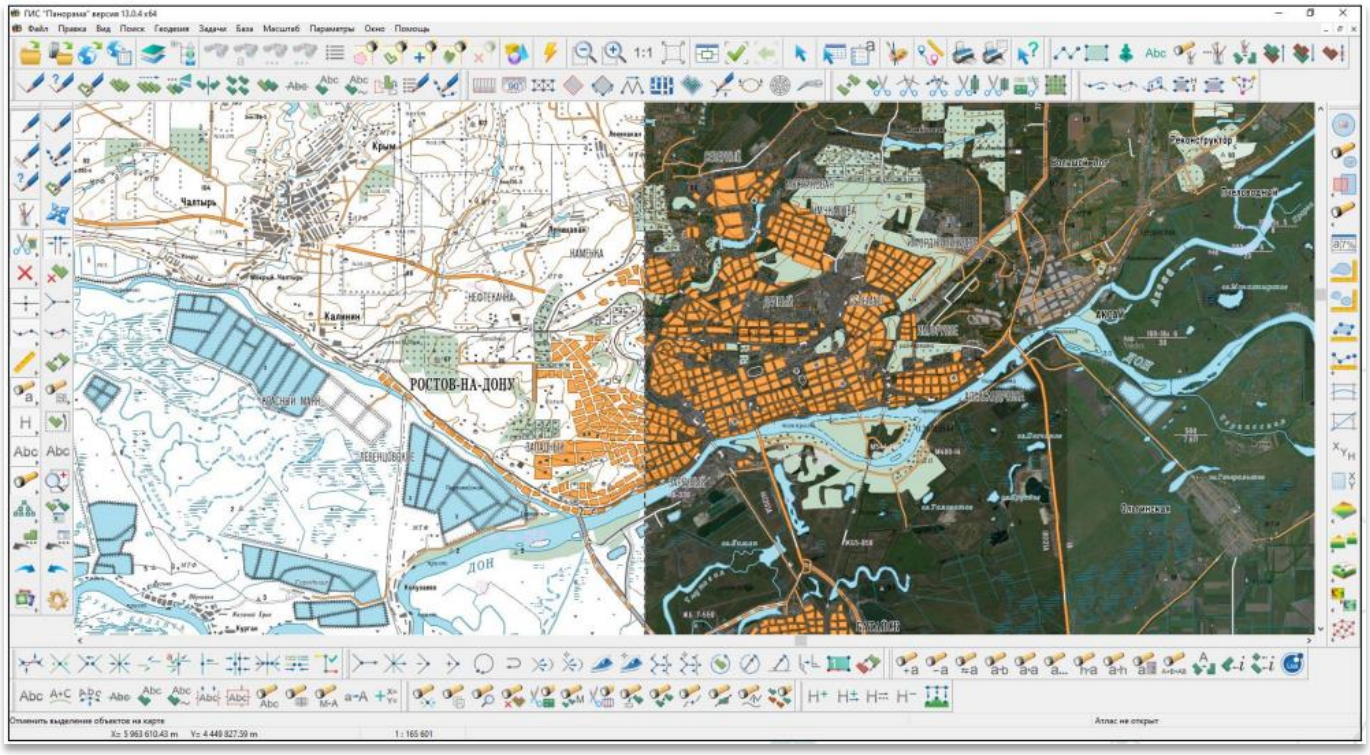
Currently, the Public Cadastral Map contains information on more than 61 million land plots and more than 44 million buildings, structures and unfinished construction projects. The information on the map is updated on a daily basis.

Users can find an object by cadastral number, address or directly on the map using navigation tools.

Thematic maps can also be viewed, formed for a particular purpose and show a special set of information. In addition, semantic and graphic information of the map can be overlaid onto a base map or satellite image.

Geoinformation market

"In the context of the development of digital technologies and the country's transition to a market economy, the industry has evolved into a complex system whose main components are geoinformation and spatial analysis services, remote sensing, geodetic survey, global satellite positioning, laser scanning and radar surveillance"[4].

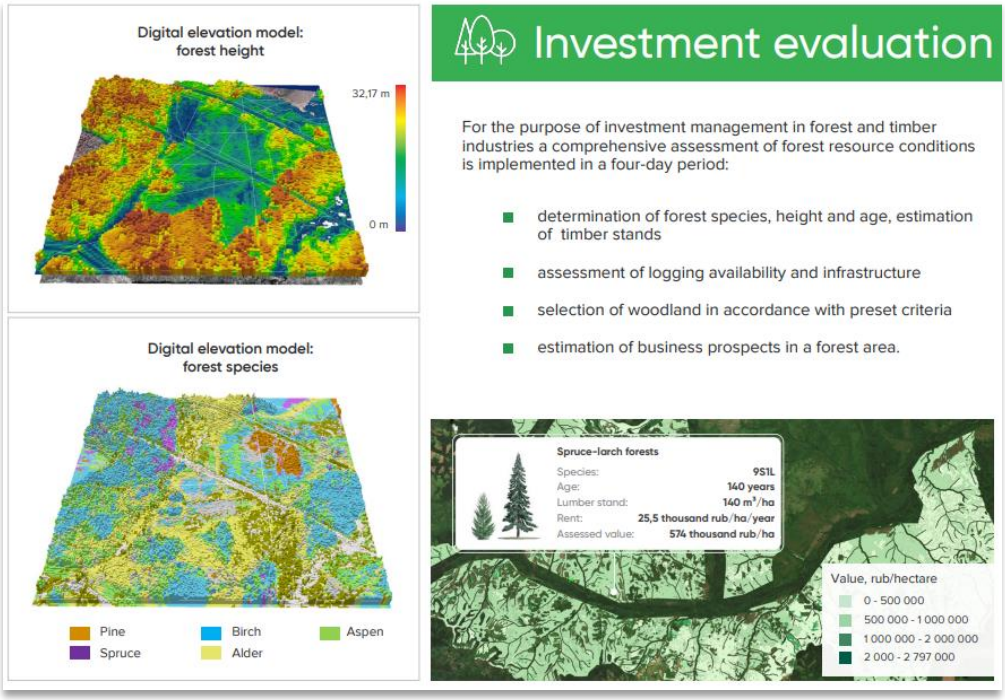


Geo-information system «Panorama»: component – editing tools of vector and raster maps of the area and putting of applicable graphic information on the map (https://gisinfo.ru/products/map12_prof.htm)

4 "Spatial Data: Economic Demands During Digitalization", Federal service for state registration, cadastre and cartography, NYI "Higher School of Economy", SRI "AEROCOSMOS", 2020

While the acquiring, processing and storing of spatial data are mostly performed by government organizations, commercial organizations add value to spatial data by producing solutions and offering services based on spatial data for various sectors of economy, citizens, and authorities.

Map of Russian cities https://2gis.ru, LLC «DoubleGIS»



TerraTech (https://terratech.ru) «Space Services for Digital Economy»: assessment of the state of the forest (geo-analytics)

Moreover, according to representatives of Russian companies, customers are increasingly moving away from the practice of purchasing raw data or data processing software, preferring geoinformation solutions and analytical products.

Rosreestr, carrying out its responsibilities in the field of legal regulation of geodesy and cartography in the Russian Federation, interacts with the professional and business community in order to develop joint approaches and evaluate the influence of state policy on the geospatial data and technology sector.
Rosreestr has established the Public Council, as well as the Scientific and Technical Council for Geodesy, Cartography and Spatial Data, which include representatives of the scientific community, industry-specific public organizations and business.

Education

There are several key specialized universities in the Russian Federation which provide bachelor's, master's, research and doctoral degree programs in geodesy, cartography, cadastre and geo-informatics. Some of them are listed below:

1. **Moscow State University of Geodesy and Cartography** is the key institution for the industry in Russia and a basic organization of the Commonwealth of Independent States for training professionals in the fields of geodesy, cartography, cadastre and Earth remote sensing.
MSUGC is a member of the UN International Committee on Global Navigation Satellite Systems, National Committee for the Promotion of Economic Cooperation with Latin America Countries, EU ERASMUS program.
A consortium with a unique level of competence, which includes Kazan Federal University, National Research Tomsk State University, and Tyumen State University, operates under the lead of MSUGC.
Official website: https://www.miigaik.ru/.
2. **The State University of Land Use Planning** was founded in 1779 and possesses a status of the main educational, methodological and scientific centre of land use planning and cadastre in Russia.
The "University complex" includes 26 education, research and production enterprises. The education programmes focus on: land management and cadastres, ecology and nature management, real estate management and development, architecture, landscape architecture, geodesy and remote sensing, etc.

The university has over 100 partnership agreements with foreign universities and organisations and coordinates the Educational and Methodological Council (Association) of Higher Education Institutions in the areas of land use planning and cadastre (94 member universities).

Official website: https://guz.ru/.

3. **Siberian State University of Geosystems and Technologies** is a specialized Russian university located in Siberia (Novosibirsk).

The university has four research institutes:

Research Institute of Strategic Development;
Research Institute of Earth Measurement;
Research Institute of Instrumentation and Optical Engineering;
Research Institute of Economics, Management and Human Sciences.

The institutes include 17 scientific schools, headed by leading scientists, and more than 40 scientific and educational laboratories and centres.

Official website: https://sgugit.ru/.

4. **Lomonosov Moscow State University**, the oldest university of Russia, is currently one of the largest Russian higher education institutions.

The MSU Geography Faculty, which also trains specialists in cartography and geo-informatics, has 15 departments, 8 research laboratories, 5 educational, and research bases, including the Laboratory of Complex Cartography and the Laboratory of Integrated Cartography, and a Geoinformation Technology Centre.

The MSU Geoportal (geoinformation system with real-time satellite data update) has been operating for more than 10 years.

Official website: https://www.msu.ru/.

Geoportal: http://www.geogr.msu.ru/science/projects/geoportal/index.php.

5. **Kazan Federal University named after N.I. Lobachevsky**, one of the leading universities in Russia, is named after the famous Russian mathematician and astronomer. As one of the oldest universities in Russia, KFU also pays considerable attention to innovative areas of scientific knowledge, while training specialists in cartography and geo-informatics, geodesy and remote sensing. One of the key partners of KFU's is the Innopolis University GIS Centre. Its team carries out science-intensive projects using artificial intelligence and spatial data for building digital models.

Official website: https://kpfu.ru/.

6. **National Research Tomsk State University** is one of 29 Russian educational institutions with the status of research universities. Tomsk Regional Branch of the

Russian Geographical Society founded in 1948 on the geographical department of Tomsk State University (TSU), which enhances a wide range of systematic scientific researches.

There are 10 scientific commissions, including commissions of physical geography and geomorphology, cartography and geoinformation technologies that participate in creation of a unified geoinformation space of Tomsk region and a corresponding geoportal.

Official website: https://www.tsu.ru/.

7. **Tyumen State University** has a wide range of geo-spatial research activities performed by the Institute of Earth Sciences. The Institute trains specialists in the fields of cartography and geo-informatics, combining a complex of disciplines in cartography, geoinformation technologies, geodesy, topography, land and urban cadastre, etc. The university has a department of Cartography and Geoinformation Systems that employs and develops new methods of using GIS systems in the environmental activities of government agencies and oil and gas sector enterprises. Scientific developments related to cartographic support of environmental design and rational use of natural resources, spatial analysis of natural and anthropogenic factors in the formation of environmental quality are part of the university's activities.

Official website: https://www.utmn.ru/.

8. **National Research University "Higher School of Economics"** trains specialists in the fields of geoinformation technologies and spatial modelling. Training is based on intersection of geography and computer science, including the field of «Big Data». Students study the entire cycle of working with spatial data – from primary collection using various monitoring systems to the creation of the final geoinformation solution.

Official website: https://www.hse.ru/.

9. **Moscow College of Geodesy and Cartography** is one of the oldest institutions of secondary professional education founded in 1920.

It trains specialists of the basic level in the fields of applied geodesy, aerial geodesy, cartography, and land and property turnover. College graduates often continue their professional studies at the MSUGC.

Official website: http://mkgik.org/.

References

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Federal Spatial Data Fund	https://portal.fppd.cgkipd.ru/main
Public Cadastral Map	https://pkk.rosreestr.ru/