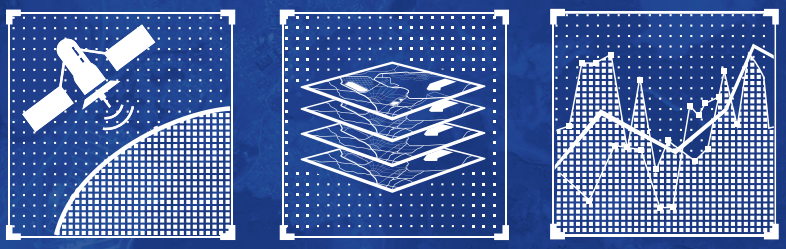
ROSCOSMOS

RSS
RUSSIAN SPACE SYSTEMS

TerraTech

RUSSIAN SPACE SYSTEMS



SPACE SERVICES FOR DIGITAL ECONOMY

Establishment background

Derective of the Russian President Vladimir Putin

Digital economy programme

Strategic initiative of Roscosmos

TerraTech RUSSIAN SPACE SYSTEMS

Established in December 2017 by a strategic initiative of State Corporation Roscosmos as a subsidiary of JSC Russian Space Systems to act as a commercial operator of ERS and GIS services.

ROSCOSMOS → RSS RUSSIAN SPACE SYSTEMS → TerraTech RUSSIAN SPACE SYSTEMS

Operations

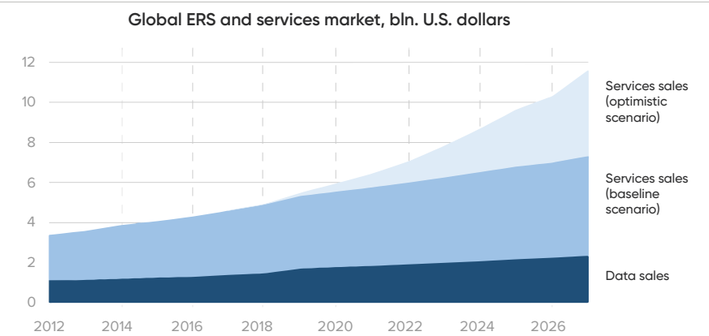
Main objective: development and implementation of cutting edge digital solutions based on spatial data, for governments, businesses and individuals.

Services provided by the company are aimed to automate ERS data gathering and analysis, deliver insights and enable streamlined decision-making.

Geospatial market

Market focus is shifting from just data provisioning towards a service model capable of providing analytical information to a wide range of customers.

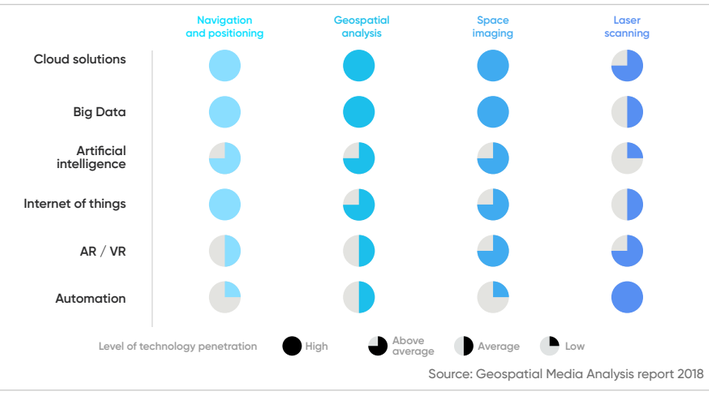
Global ERS and services market, bln. U.S. dollars



Source: Euroconsult report 2018

Technological drivers of ERS market

JSC TERRA TECH is developing geospatial solutions in line with key technological drivers and international trends of the present day.



Source: Geospatial Media Analysis report 2018

Spatial data sources

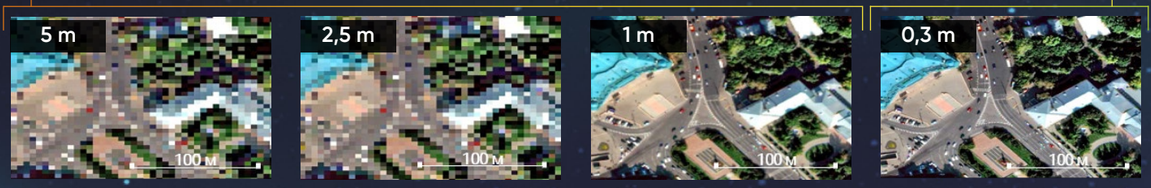
JSC Terra Tech supplies space imagery acquired by most commercially-available ERS satellites accompanied by aerial images, including the ones captured by unmanned systems (UAV). This approach makes it possible to deliver imagery within minimal time range and with high efficiency, even on a daily basis.

SPACE IMAGERY

Spatial resolution 0,3 - 15 m

AERIAL IMAGERY

5 - 20 sm Spatial resolution



Today more than 600 ERS satellites are operating in orbit and their numbers are steadily growing.

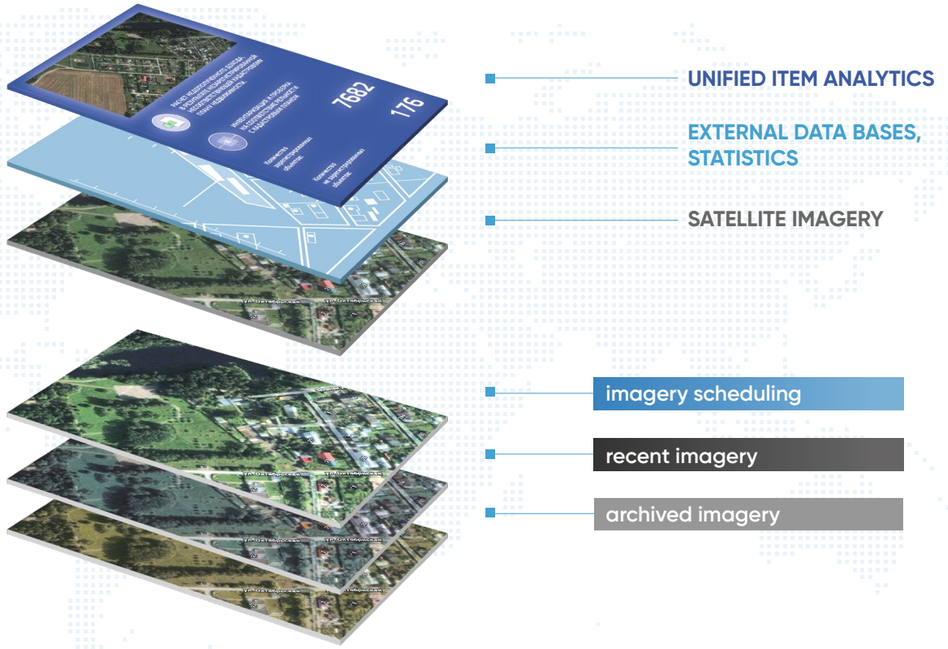
2015
DOZENS OF ERS SATELLITES IN ORBIT
x10

2020
HUNDREDS OF ERS SATELLITES IN ORBIT
x100

2025
THOUSANDS OF ERS SATELLITES IN ORBIT
x1000

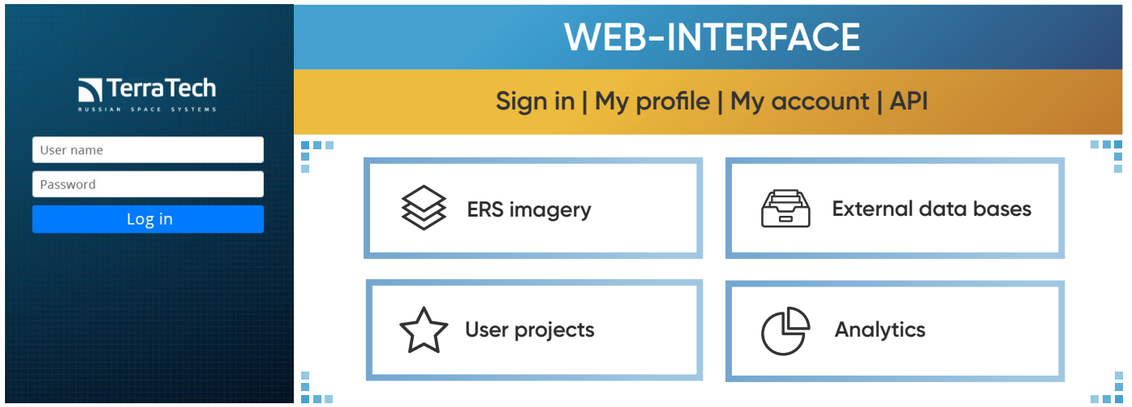
Integrated ecosystem of geoservices

Tasked to create new digital solutions we at JSC TERRA TECH have embraced modern ‘from image to analytics’ approach and built a universal platform capable of satisfying the needs of all our consumers.



User-friendly web interface with a unified authentication system provides a single-window-access to a wide range of options for geospatial data:

- Upload any thematic geospatial data
- Use a wide range of analytical tools
- Download reports with various levels of detail in digital format of choice



Integrated geoservice platform

Our integrated geoservice platform provides a set of tools (mapping statistics, analytical reporting, geospatial query and others) universally available in a single digital environment to use with any uploaded thematic spatial data.

- Commercial cloud of ERS imagery TerraCloud
- Forestry
- Agriculture
- Fossil fuels: oil and natural gas
- Mining: open mines
- Insurance
- Business activity: construction
- Business activity: agriculture
- Waste landfills
- Ecology
- Terrain
- Investment
- Change detection
- ATLAS VR
- Aerial survey and 3D modeling
- Artificial intelligence

TerraCloud

On-line ERS data purchase

TerraCloud provides one-window access to the database of space imagery of various resolutions acquired by Russian satellites over time. TerraCloud is a web solution and all the imagery is available on demand 24/7 from every corner of the world.

TerraCloud database is constantly growing. It features not only archived imagery, but also allows users to place orders for new image acquisitions.

Resurs-P

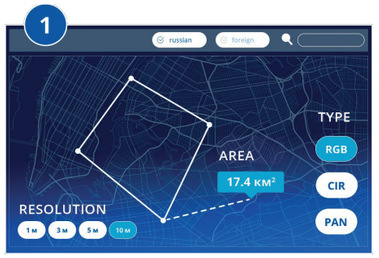
Resolution:
- panchromatic . . . . . 0,8 m
- multispectral . . . . . 3 m

Kanopus-V

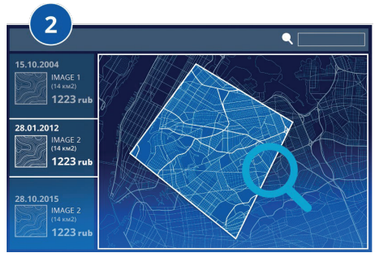
Resolution:
- panchromatic . . . . . 2,5 m
- multispectral . . . . . 12 m

HOW IT WORKS?

Select area of interest



Preview imagery



Purchase and download instantly

Geoservice streamlines spatial data ordering and provides constant flow of relevant data necessary for efficient monitoring and oversight by government bodies and commercial companies.

Private individuals, medium and small businesses benefit from the geoservice in solving their problems related to mapping, land use, area planning. Data provided through TerraCloud can be used as evidence in land and property lawsuits.

1 km²
Minimum order area

up to 0,8 m
Image resolution

₽
Minimum purchase value

FORESTRY

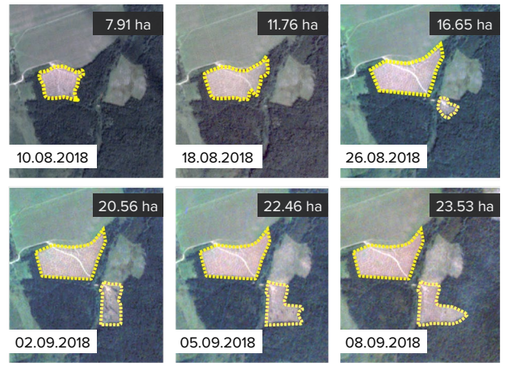
Terra Tech implements a comprehensive monitoring of forest resources and provides systematic assessment of forest change dynamics:

- mapping forest resources
- detection, monitoring and oversight of illegal clearings
- identification of forest species and forest constitution by age, estimation of timber stands
- detection of forest fires, forecast of emergency development
- tracking harmful processes (plantation destruction, windfalls, snowbreaks, pests, diseases)
- accounting results of natural and artificial forest regeneration.

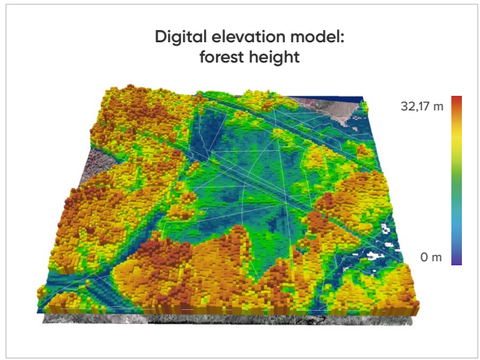
Deforestation

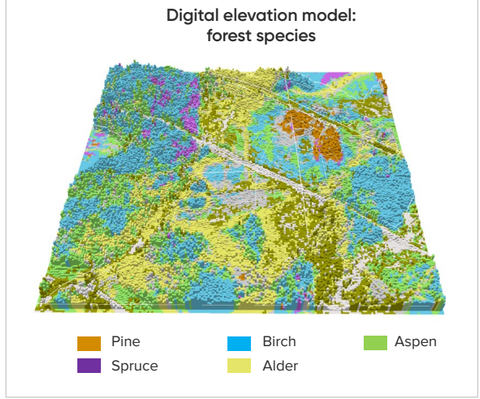
Monitoring can be implemented with high frequency (every 36 hours) with an automated detection of deforestation, its type and legitimacy:

- determination of logging area boundaries
- comparison of actually logged areas with officially determined boundaries
- estimation of logged area size, assessment of performed work quality.



Dynamics of illegal deforestation

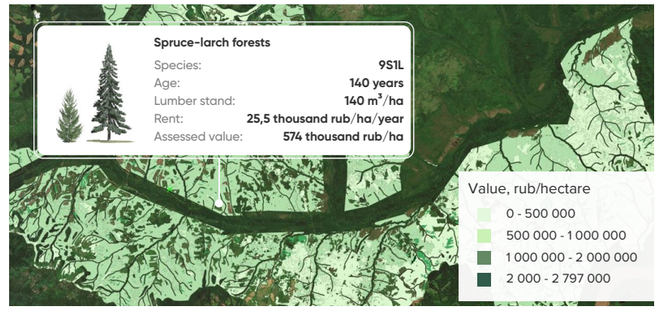




Investment evaluation

For the purpose of investment management in forest and timber industries a comprehensive assessment of forest resource conditions is implemented in a four-day period:

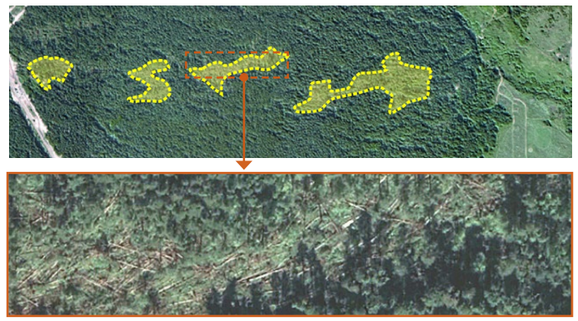
- determination of forest species, height and age, estimation of timber stands
- assessment of logging availability and infrastructure
- selection of woodland in accordance with preset criteria
- estimation of business prospects in a forest area.



Forest pathology

Distant examination for forest pathology is conducted during a four-day period to identify dead standing and damaged trees. The results of such forest pathology research are verified on the basis of terrain data.

- windfalls
- pests
- drying



Automated detection of windfall areas

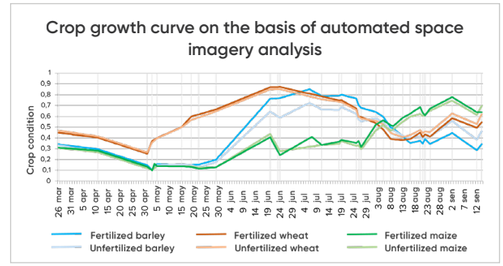
AGRICULTURE

ERS data allows to perform an integrated operational monitoring in an agricultural sector, assess structure and composition of sown areas, analyze efficiency of land use and forecast crop yield:

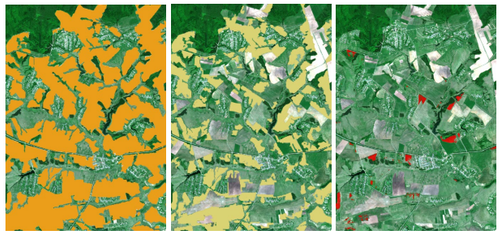
- agro-climatic monitoring
- actual crop condition monitoring
- distant monitoring of field operations
- certification of fields and other assets of an agricultural company
- precise farming
- development of recommendations on differential applications of fertilizers, plant protection agents, seeds.

Crop conditions

- stock-taking and certification of croplands
- display and control of information on the current condition of crops, vegetation index (NDVI)
- analysis of crop condition changes upon implementation of planned activities
- establishment of fertilizer application needs
- monitoring efficiency of fertilizer applications
- forecast of field crop yield
- assessment of climate and weather condition impact.



Assessment
of land use efficiency



Agricultural lands cultivated from 1980s

Uncultivated arable lands (deposits)

Overgrowing with trees and shrubs

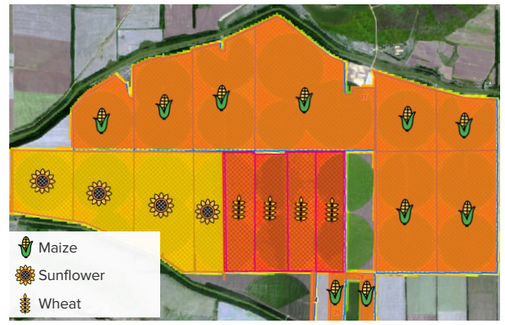
Efficient land use

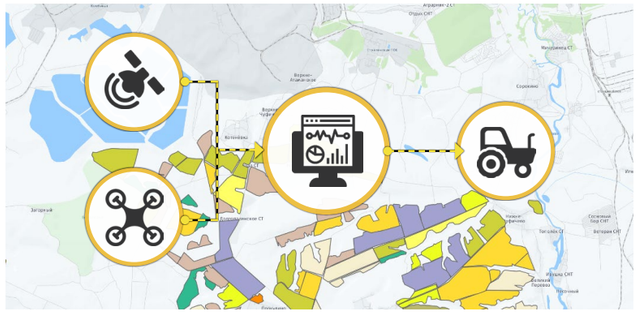
- assessment of land conditions favorable for organic farming
- monitoring crop rotation and comparison of crop planting plans with an actual condition on the basis of ERS data
- tracking harmful process dynamics (overgrowing, swamping and others)

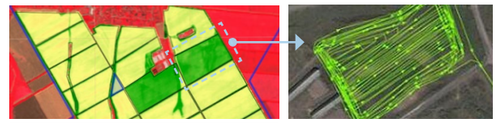
Precise farming

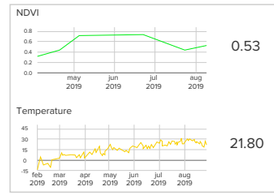
Application of current technologies in crop yield management enables farmers to precisely calculate the required quantity of seeds, fertilizers and other resources for each plot of land as well as to automatically steer agricultural machinery and equipment.

The bank of agricultural indices based on geoanalysis allows to perform multi-factor crop yield analysis fast.









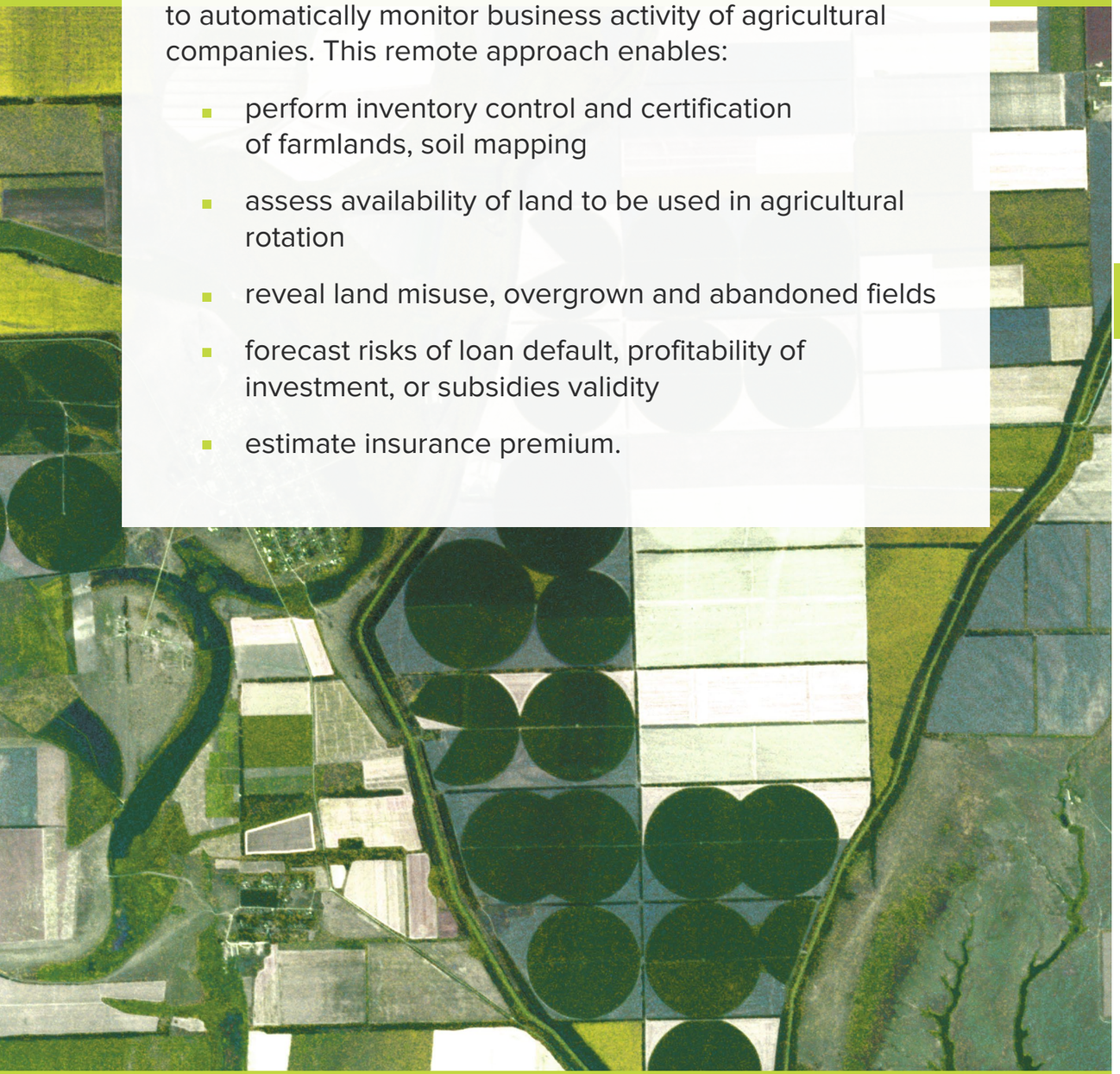
Fertilizer application monitoring

Status:	In progress
Time frames:	29.06 - 30.06.2019
Fuel, unit:	10
Type of fuel:	Diesel
Num. of shifts:	15
Num. of persons in a shift:	12
Shiftoutput, unit:	10

BUSINESS-ACTIVITY: AGRICULTURE

JSC Terra Tech implements space technologies to automatically monitor business activity of agricultural companies. This remote approach enables:

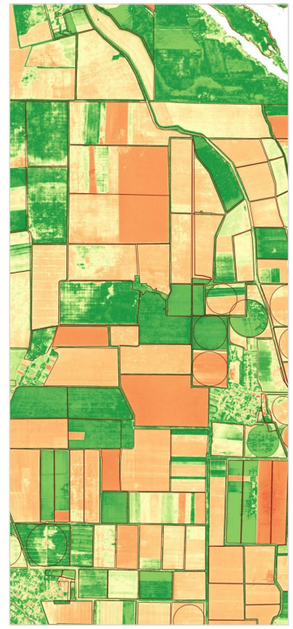
- perform inventory control and certification of farmlands, soil mapping
- assess availability of land to be used in agricultural rotation
- reveal land misuse, overgrown and abandoned fields
- forecast risks of loan default, profitability of investment, or subsidies validity
- estimate insurance premium.

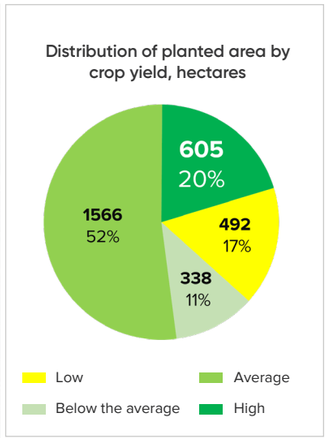


Capabilities

It is possible to monitor business activity of agricultural companies with any level of details and frequency, even on a weekly basis. Customer is provided with a geoanalytical report within three days. The report comprises of an assessment of farming land conditions and a detailed appraisal of each field relating to its use legitimacy:

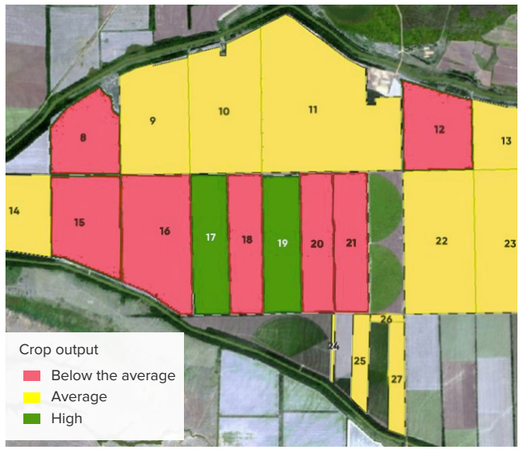
- estimation of field shares in use
- estimation of field shares in misuse
- share of each field area used for the purpose intended
- assessment of harmful process developments with respect to each field.





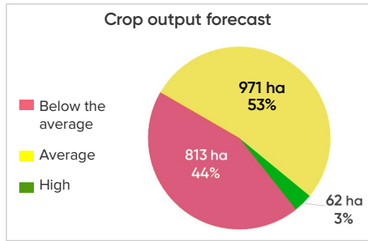
Parameter	Area (hectares)	Planted area share (%)
Harvested crops	452	54
Standing crops	384	46

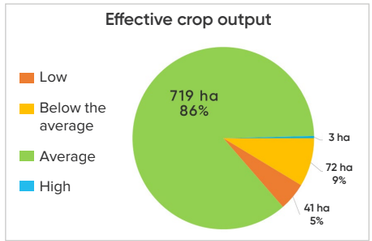
Evaluation of a farming company validity

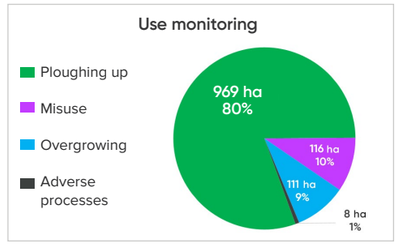


Integrated assessment of reliability and validity of a farming holding is made using data collected during space monitoring of agricultural assets of companies and forecasts of future field crop output:

- functional capabilities of each field
- assessment of process developments on each field
- tracking stages of a field use
- comparative forecast of crop output
- consolidated assessment of reliability and validity of an agricultural company.





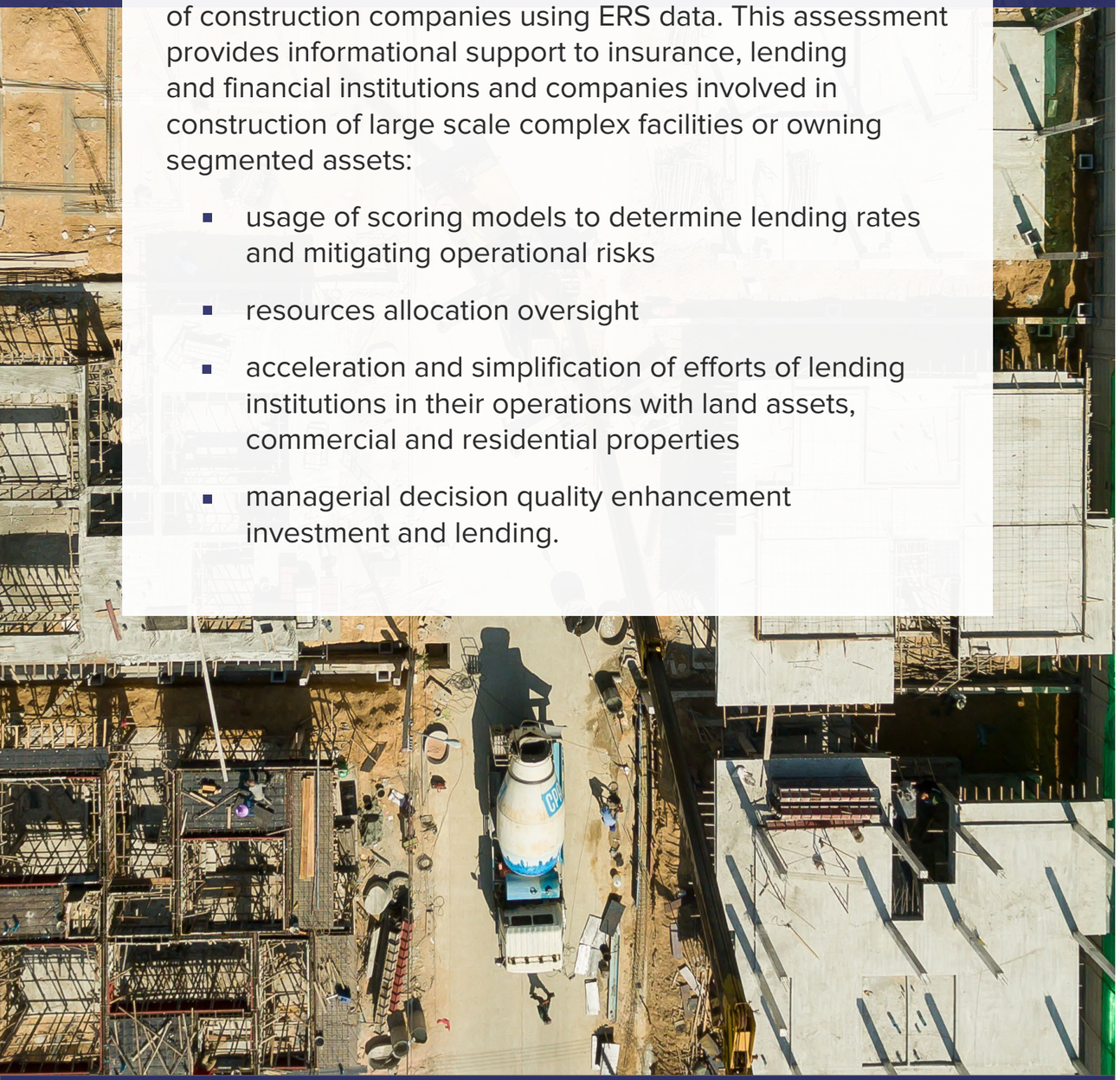


N°	Cadaster number	Area, hectares	Misused	Area share, %				Harmful process	
				Ploughing up	Building	Pits	Overgrowing	Type	Area share,%
1	xx:xx:xxxxxxx	427	yes	88	0	0	12	erosion, planar washout	12
2	xx:xx:xxxxxxx	227	yes	34	20	29	17	swamping	17
3	xx:xx:xxxxxxx	48	no	0	17	6	77	none	0

BUSINESS-ACTIVITY: CONSTRUCTION

GIS services allow to assess business activity of construction companies using ERS data. This assessment provides informational support to insurance, lending and financial institutions and companies involved in construction of large scale complex facilities or owning segmented assets:

- usage of scoring models to determine lending rates and mitigating operational risks
- resources allocation oversight
- acceleration and simplification of efforts of lending institutions in their operations with land assets, commercial and residential properties
- managerial decision quality enhancement investment and lending.



Capabilities

As a result of space image processing within three days customer is provided with a geoanalytical report comprising of updates on facility construction progress and activity assessment of construction equipment operations.

It is possible to establish a monitoring of business activity with various levels of detail and frequency, even on a daily basis.

- assessment of construction status
- facility development progression with imagery validation
- estimation of displaced soil volumes with an accuracy up to 95% when using stereo imagery
- estimation of number of construction equipment and its operating activity
- estimation of number of construction materials and their usage dynamics.

COUNTRY LEVEL
Space images of large coverage.

Selection of a site, surveying, designing, logistics, ecological, social and economic situation monitoring.

FACILITY LEVEL
Space mono and stereo surveying.
Multipass radiolocation.

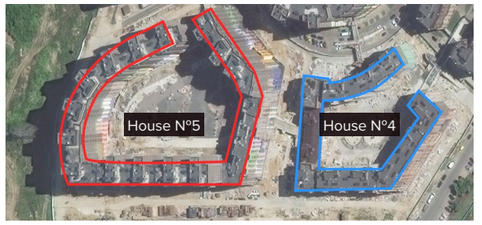
Volumes evaluation, facility construction, equipment availability, construction safety.

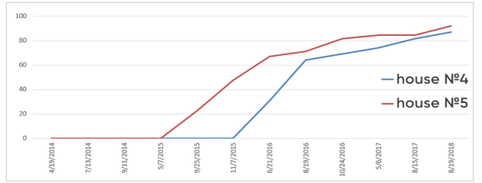
ON-SITE LEVEL
UAV imagery, video cameras at the facility, 3D scanning.

Detailed local monitoring of construction progress.

LOCAL LEVEL
Video cameras, 3D scanning, other sensors.

Detailed local monitoring of construction progress, both inside structures, and at a unit level.





Facility	House N°4	House N°5
Work stage	Building construction	Building construction
Condition	Finishing works, improvement of a territory	Building construction
Dynamics in comparison with a previous report	Low dynamics	Low dynamics
Availability degree	87%	92%
Availability progress in comparison with a previous report	5%	8%
Advances and slippages on schedule, month	-13	-14

Reliability assessment

Integrated assessment of reliability and validity of a developer is implemented through comparing time frames of a facility construction stipulated in a schedule with actual data collected during space monitoring.

- comparison of construction stages with scheduled works, assessment of advances and slippages on schedule
- integrated reliability assessment of a developer
- activity ratings of developers and competitors
- estimation of costs for construction activities.

Construction material storage

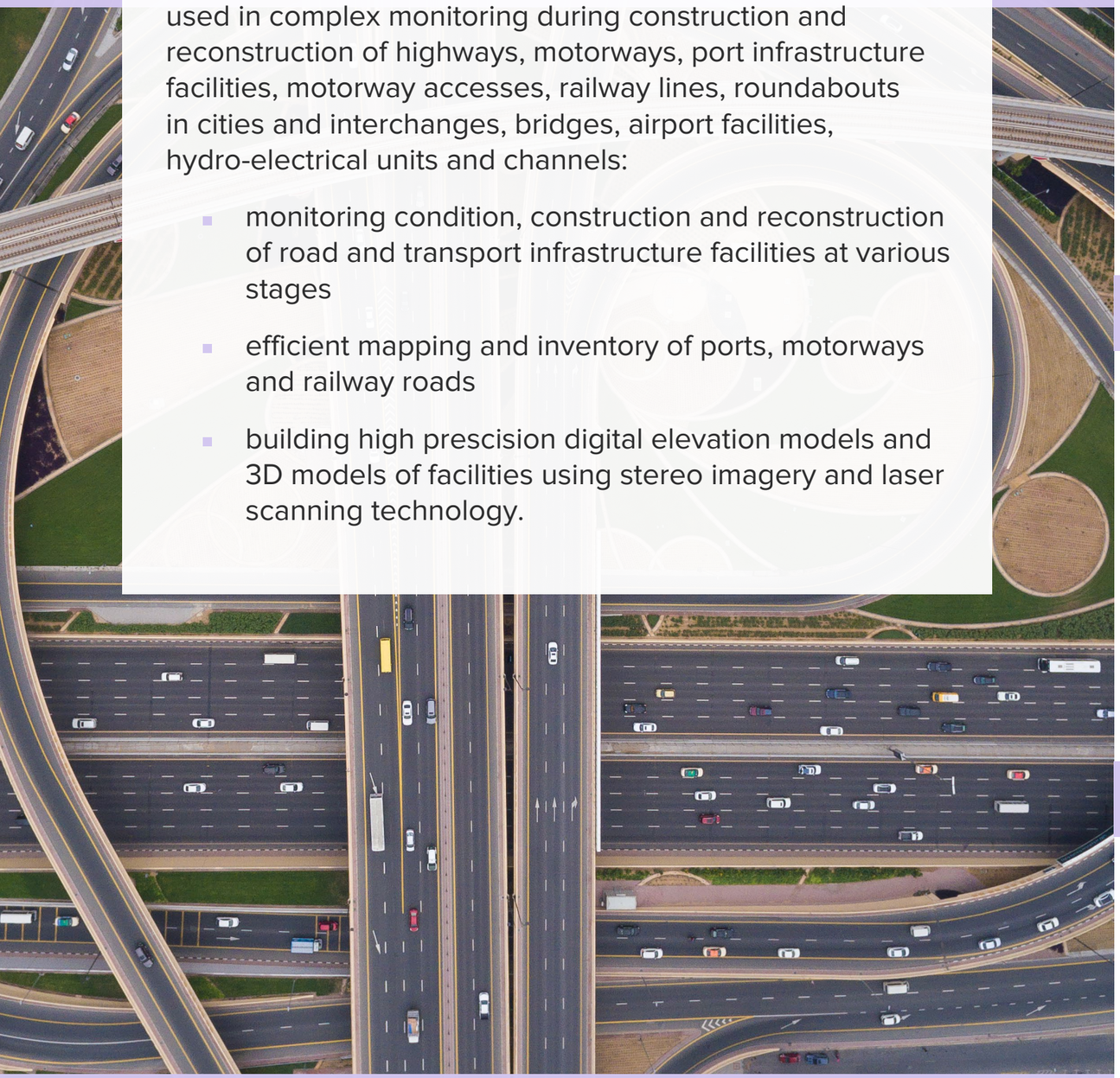
Iron rings | Concrete box units | Reinforcement

Contractor	Facility	Area, hectares per km	Date	Commitment fulfillment	Slippage	Construction is frozen	Construction paces			Grade (0-10)	Solvency level
							Rapid	Average	Slow		
Developer 1	Highway	1 100	2018	Yes	No	No	8	2	-	8	High
Developer 2	Residential house	5	2019	Yes	No	No	-	3	2	5	Average
Developer 3	Underbridge	4	2017	No	1 year	Yes	-	-	1	2	Low

ROAD INFRASTRUCTURE

Space technologies applied by JSC TERRA TECH are used in complex monitoring during construction and reconstruction of highways, motorways, port infrastructure facilities, motorway accesses, railway lines, roundabouts in cities and interchanges, bridges, airport facilities, hydro-electrical units and channels:

- monitoring condition, construction and reconstruction of road and transport infrastructure facilities at various stages
- efficient mapping and inventory of ports, motorways and railway roads
- building high prescision digital elevation models and 3D models of facilities using stereo imagery and laser scanning technology.

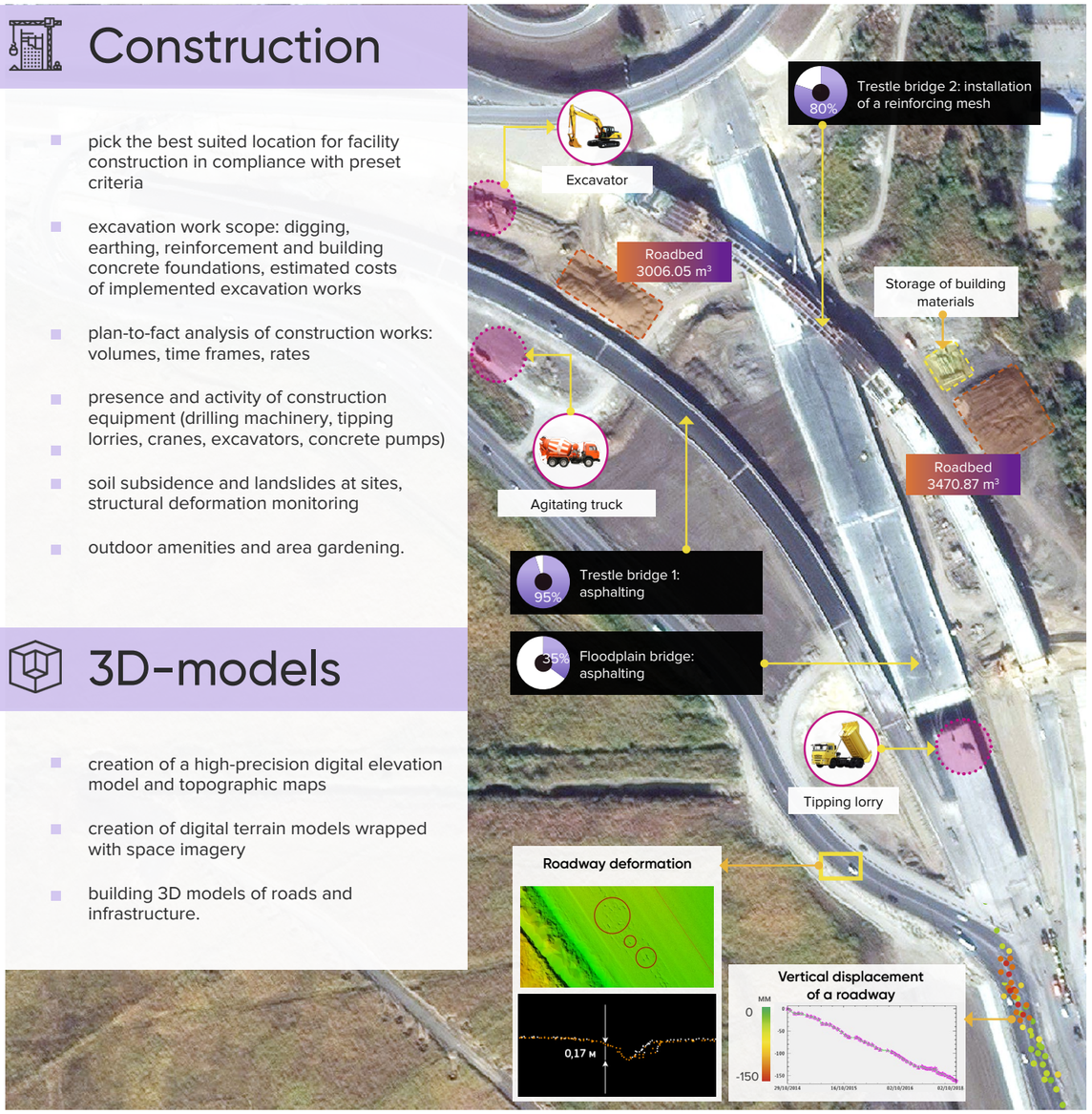


Construction

- pick the best suited location for facility construction in compliance with preset criteria
- excavation work scope: digging, earthing, reinforcement and building concrete foundations, estimated costs of implemented excavation works
- plan-to-fact analysis of construction works: volumes, time frames, rates
- presence and activity of construction equipment (drilling machinery, tipping lorries, cranes, excavators, concrete pumps)
- soil subsidence and landslides at sites, structural deformation monitoring
- outdoor amenities and area gardening.

3D-models

- creation of a high-precision digital elevation model and topographic maps
- creation of digital terrain models wrapped with space imagery
- building 3D models of roads and infrastructure.



Logistics

- updating road and transport network data: stock-taking and detection of new roads
- making logistic routes more efficient to reduce time and money costs of delivering construction materials to a facility construction site.

INSURANCE

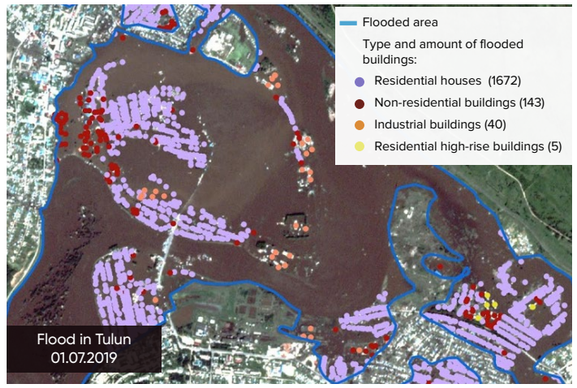
Modern geoinformation solutions provide insurance companies with analytical information which help to reduce risks and optimize rates for insurance objects:

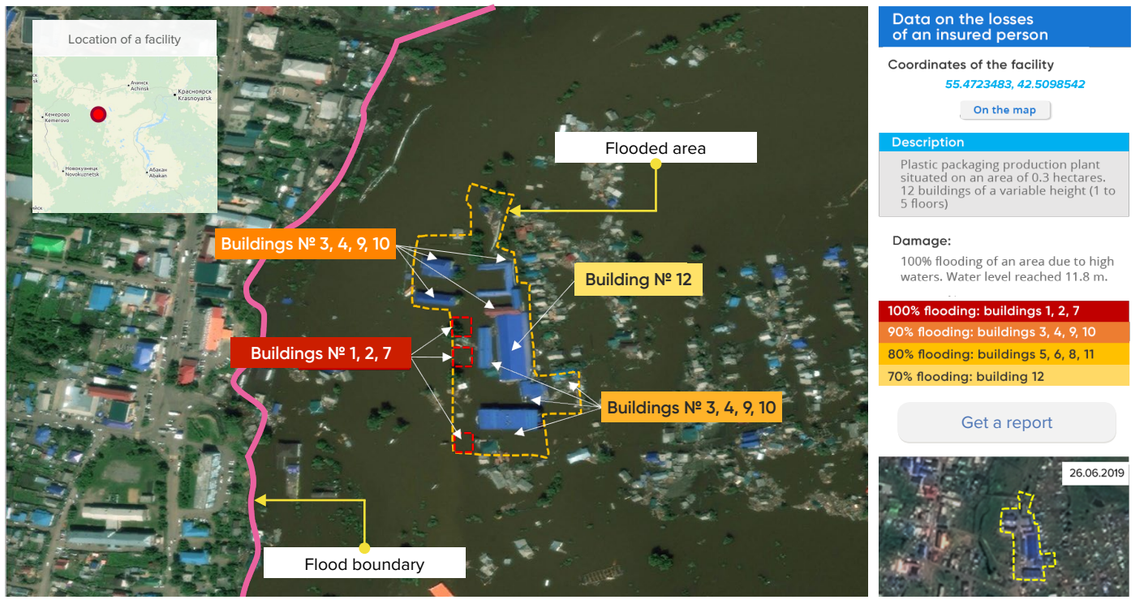
- near real-time monitoring of insured territory and assets of insured persons and organizations
- forecasting adverse processes and events, risk assessment
- preliminary assessment of the damage caused and pace of aftermath elimination
- verification of insurance cases, exposure of fraud
- expert review and reports for court cases.

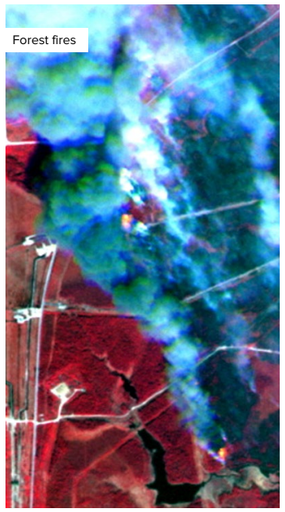
Damage assessment

Near real-time monitoring of insured areas and assets of insured persons and organizations is set to determine and evaluate the condition of real estate objects throughout the period of insurance:

- establishing the fact and timeframe of insured event occurrence
- establishing the source of negative process and its causes.







Risk determination

- retrospective and near real-time monitoring of floods, high water, fires, and other natural disasters
- prospective analysis of work necessary to prevent disasters and eliminate its consequences
- civil liability insurance of organizations operating dangerous objects: assessment of dangerous objects environment for potential damage to the environment.

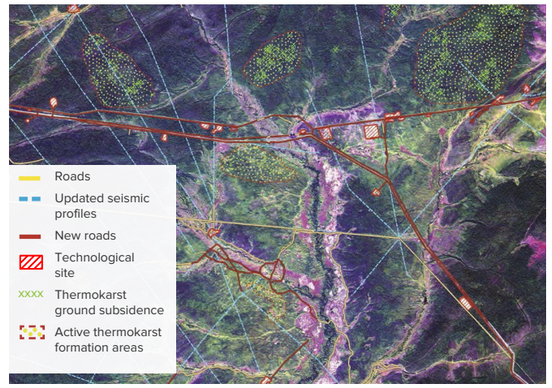
OIL AND NATURAL GAS INDUSTRY

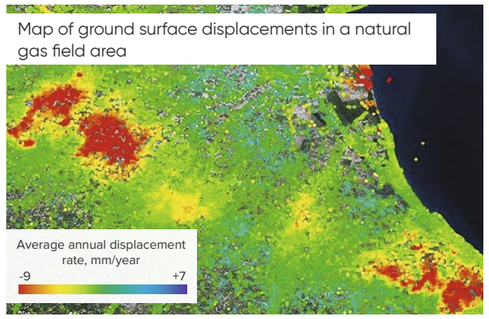
Industries involved in extraction, transportation and storage of energy commodities benefit from ERS services and applications in a number of ways. These services are aimed to provide companies with impartial, systematic, near real-time information relating to:

- extraction and transportation facilities infrastructure monitoring
- area monitoring (geological survey and ecological monitoring)
- near real-time analytics
- facilities infrastructure inventory
- emergency (forecast and risk assessment, analysis of development paces, rapid data collection).

Survey

- exploration and assessment of prospecting well site conditions, assessment of an initial natural environment conditions
- assessment of transport accessibility and logistics in undeveloped areas
- development of site plans and maps
- monitoring and evaluation of seismic and drilling operations.



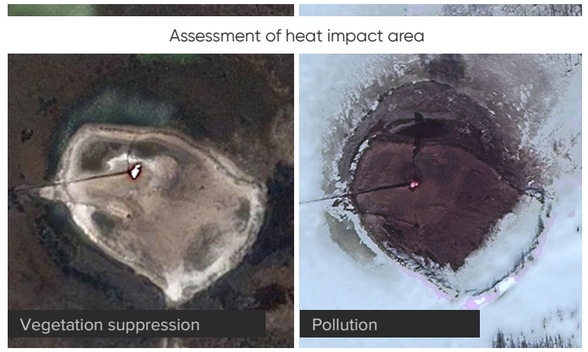


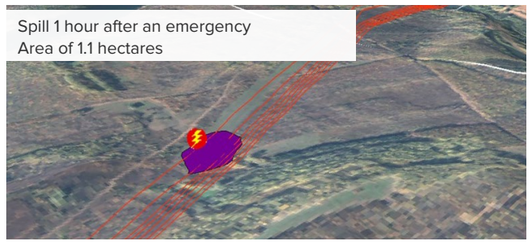
Extraction

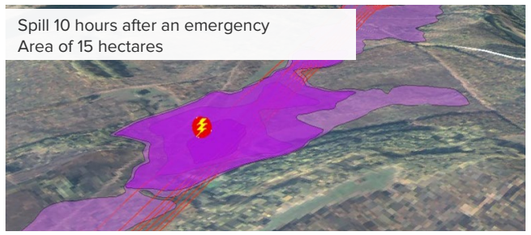
- monitoring and supervision of construction works, monitoring reservoirs and pits, verification of boundaries compliance with the land allotments
- assessment of man-made area disturbances, oil spills detection
- monitoring vertical displacements of land surface.

Processing and transportation

- detection of associated petroleum gas popping sites, determination of popping volumes, assessment of heat impact area
- inventory of pipelines
- detection of potential corrosion sites
- monitoring repair and construction works.







Remediation

- monitoring oil pollution remediation
- assessment of changes in environmental components
- monitoring emergency aftermaths
- improvement of emergency prevention measures, forecasting and simulation of emergency aftermaths.

Simulation of emergency aftermaths based on digital elevation models (DEM)

3D visualization

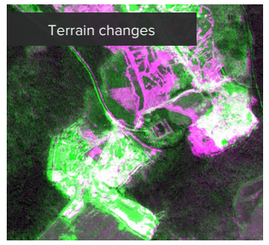
MINING: OPEN PITS

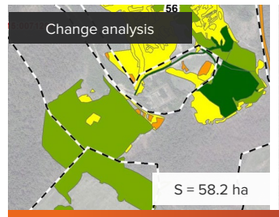
Space monitoring is used in multiple ways during geological surveys, when those take place on vast territories with poor accessibility, as well as in the course of widespread mineral deposits opencast mining:

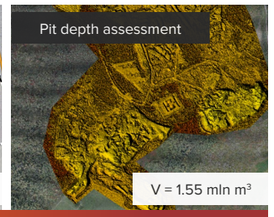
- facilities inventory and production management
- mining operations permission control
- industrial safety assessment based on radar survey, which allows to detect vertical surface displacements
- environmental monitoring with a possibility of economic calculation of direct and collateral damage to nature.

Extraction

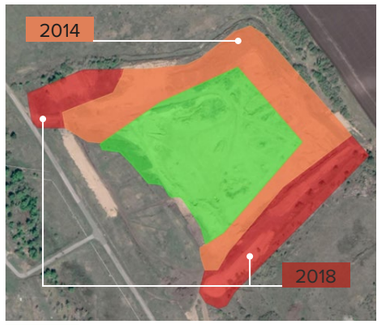
- search for extraction site and its condition monitoring, assessment of transportation accessibility and logistics
- pit inventory: location, quantity, size, condition, extraction volume
- verification of legal validity: availability of licenses for development, compliance with the site boundaries monitoring
- assessment of economic and environmental damage from illegal mining
- monitoring construction waste disposals
- ecological status of territories, pollution reclamation and emergency aftermath monitoring.

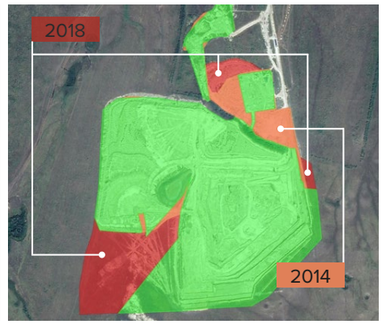


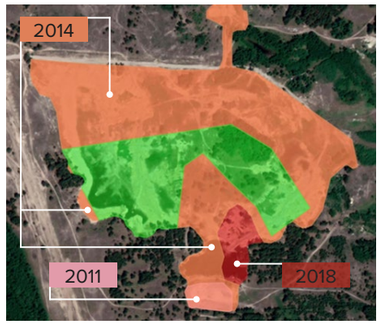




Damage from unlicensed development of widespread minerals: 347 MLN RUB.



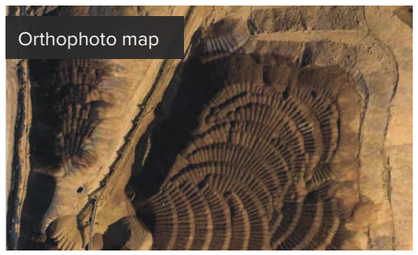


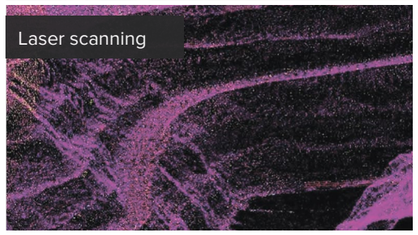


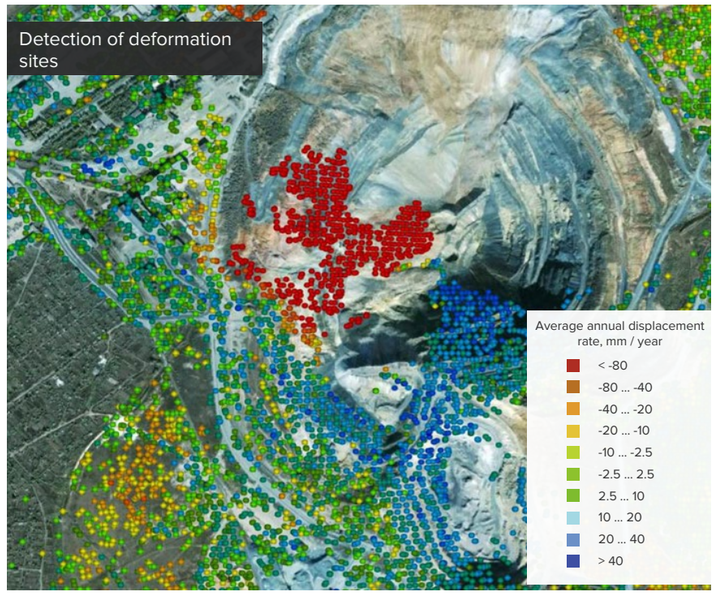
Legitimate part of the pit
Violation of the licensed area boundaries in 2011, 2014, 2018

Surface displacements

Remote sensing radar imagery and LiDAR data can detect displacements and deformations of the earth surface in the area of pits with accuracy up to millimeters.



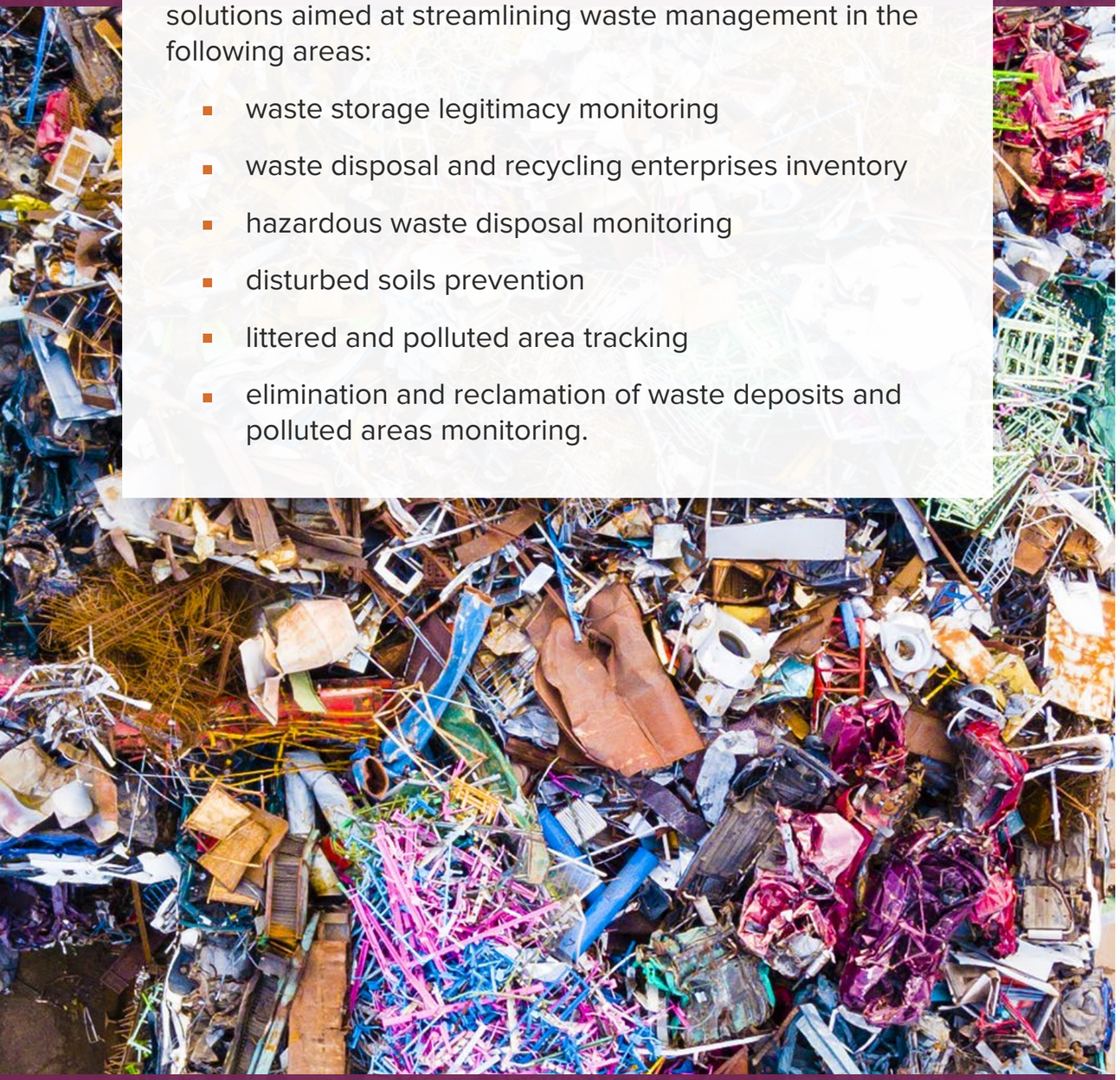




SOLID WASTE LANDFILLS

Remote sensing data helps us provide geoinformation solutions aimed at streamlining waste management in the following areas:

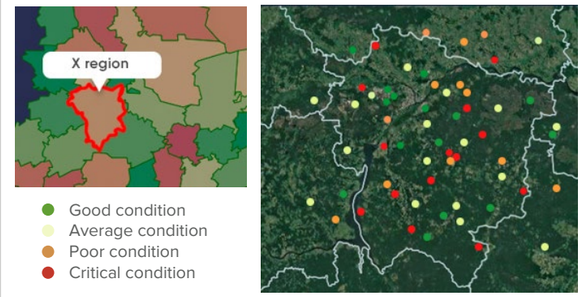
- waste storage legitimacy monitoring
- waste disposal and recycling enterprises inventory
- hazardous waste disposal monitoring
- disturbed soils prevention
- littered and polluted area tracking
- elimination and reclamation of waste deposits and polluted areas monitoring.

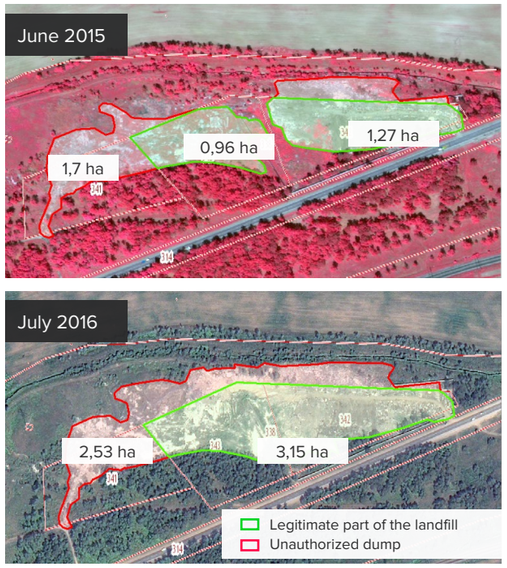


Condition analysis

- monitoring authorized and illegal storage sites for solid waste, detection of new deposits
- determining the legitimacy and cadastral violations when allocating landfills and waste deposits
- waste management maps development based on ERS data.

Rating of solid waste landfills within the area of interest



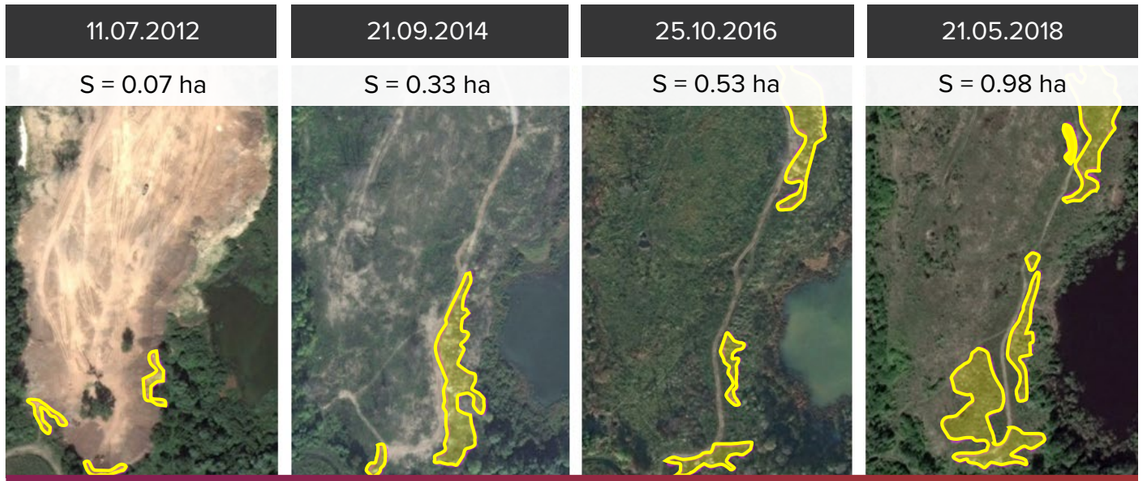


Damage assessment

- monitoring works on the elimination and reclamation of waste deposits, disturbed and polluted soils
- assessment of economic and environmental damage incurred
- monitoring the timing, paces and dynamics of construction of waste management infrastructure facilities.

Solid waste landfill and large communal unauthorized dump

Damage from unlicensed dump*
5,1 MLN RUB.



ENVIRONMENTAL DAMAGE: 1,2 MLN RUB.

* The amount of damage is calculated according to the Methodology approved by the Ministry of natural resources and ecology of the Russian Federation for calculating the amount of damage caused to soils as objects of environmental protection (order No. 238 from July 8, 2010).

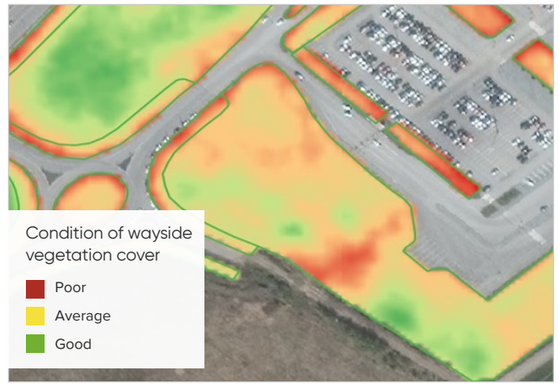
ECOLOGY

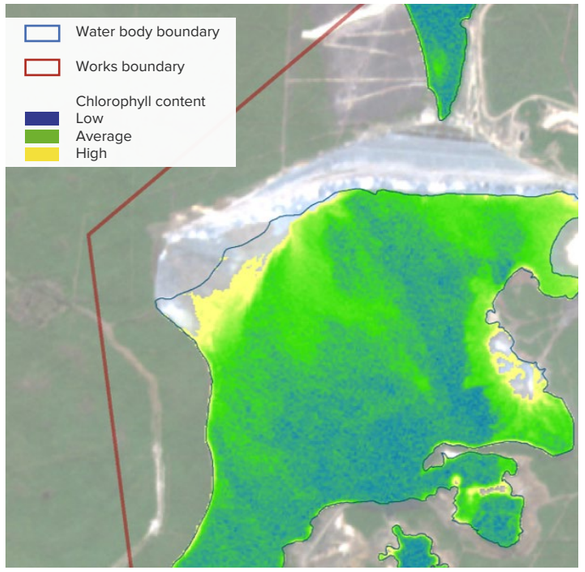
ERS data and digital services are widely used to detect and solve environmental problems and are included in the national «Ecology» project:

- territorial environmental monitoring
- assessment of economic and environmental damage incurred to nature
- environmental damage elimination and land reclamation progression monitoring
- improvement of environmental management systems of companies and organizations
- forecast and analysis of natural and man-made occurrences and events vital for the environment.

Ecological monitoring

- integrated environmental maps of territories, cities and countries
- cartograms of vegetation cover condition
- detection and monitoring of pollution dynamics (mechanical, chemical, thermal, anthropogenic) and adverse exogenous processes (erosion, landslides etc.)





Map chart of chlorophyll content in water

Air and water

- detection of sewage waters diverted to water basins contamination
- tracking emergencies in water basins (accidents, oil spills, wastewaters, others.)
- monitoring elimination of polluting objects and accumulated environmental harm posing a threat to water bodies
- monitoring efficiency of the measures for ecological situation improvement and reservoir purification
- monitoring the timing and paces of construction and reconstruction of treatment and water engineering facilities.

Biodiversity and ecotourism

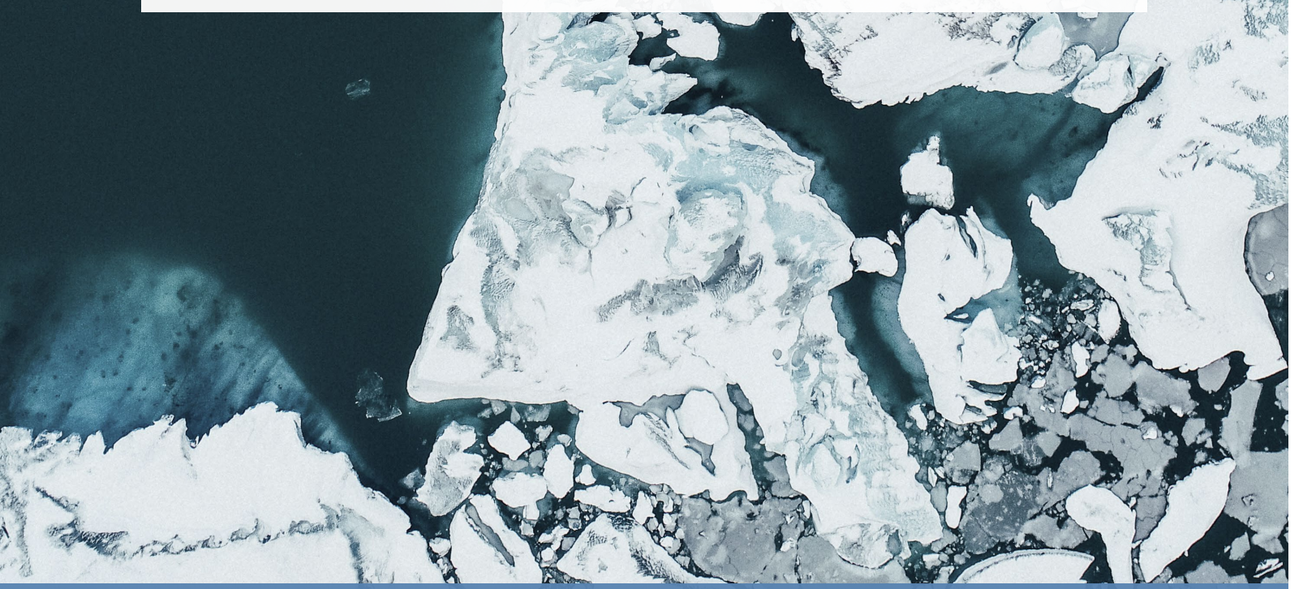
- monitoring and assessment of protected areas (natural reserves, national parks)
- monitoring unauthorized activities in protected natural areas – logged lands, dumps, construction, unauthorized land acquisition
- mapping lands, monitoring evolution of valuable landscapes (degradation, disappearance)
- development of virtual eco-tourism, environmental education, strengthening environmental and scientific voluntary activities, attracting investors.

GLOBAL CHANGES

Current technologies of automated satellite imagery processing allow JSC TERRA TECH to create a global information product aimed at rapid detection of changes occurring in the country and worldwide based on massive archive of imagery accumulated in recent decades.

The main function of the service is to provide comprehensive supervision and constant monitoring of various types of economic activity, paces of territorial developments, level of man-made impact in the following areas:

- construction
- mining
- forestry
- agriculture
- road infrastructure
- telecommunications

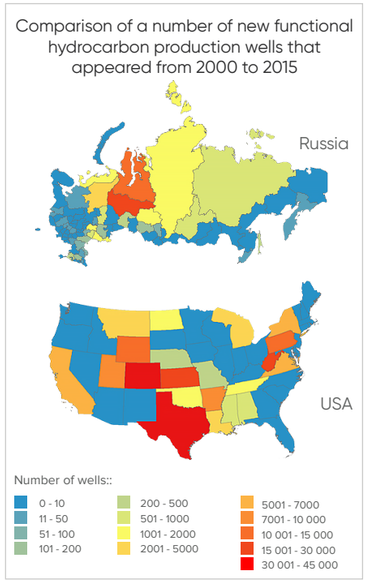


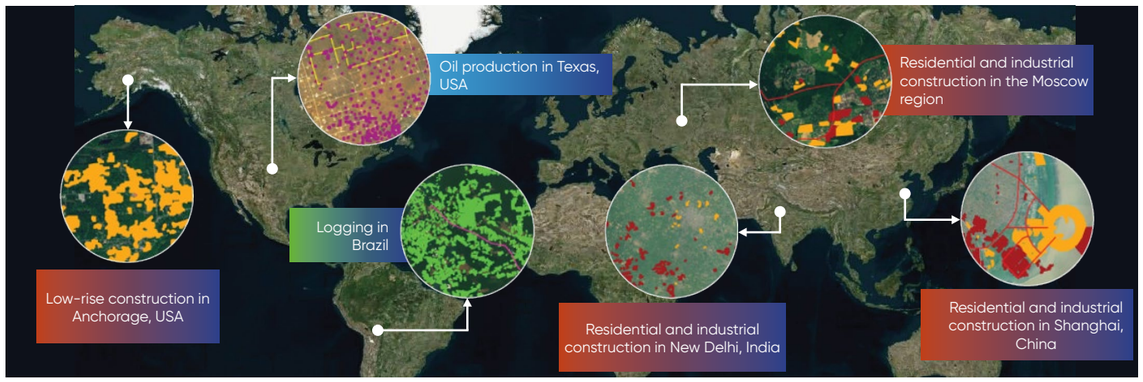
Cross-country comparisons

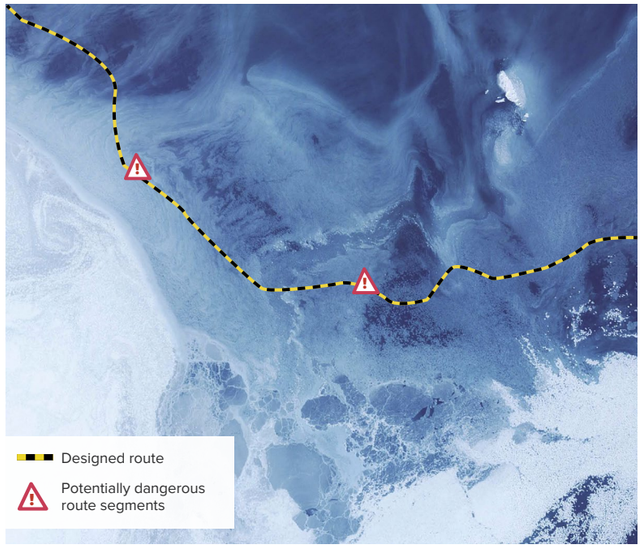
ERS data serves as a foundation for the assessment of changes on a global scale. Most of critically important sectors, such as fuel and energy, industry, mining, transportation, agriculture and forestry, construction, are well observable from space in retrospect. ERS data and services are used for:

- assessing and forecasting dynamics of a particular economic activity, such as trade, export, import, developments of various infrastructure, on a global, macro-regional and domestic levels. Using the data allows to make environmental assessments on the scale of countries, regions, industries
- awareness of dynamics of various processes developments in other countries of the world ensures independence and security of the country.

Source: data.gov







Arctic

Observation of the Arctic region from the space is conducted using optical and radar ERS satellites. Earth remote sensing allows to conduct a wide range of monitoring tasks:

- snow cover
- industrial construction zones, residential and non-residential construction
- mining infrastructure.

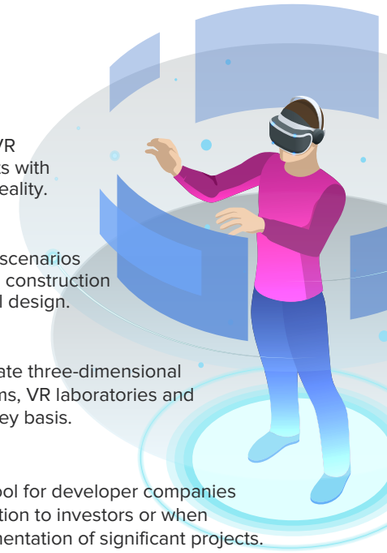
Tracking the movement of snow and ice

ATLAS VR

DIGITAL TWIN OF THE EARTH

ATLAS VR is a unique virtual reality technology that uses ERS data to create digital copies of infrastructure objects, investment projects, geographical, historical, cultural and other objects. This technology provides a great degree of immersion when interacting with objects in a virtual environment.

Applications



EDUCATION
VR-lessons in geography, geoecology, biology, life safety, history, astronomy, computer science, economics; career guidance.

PRESENTATION
Interactive multimedia VR presentations of projects with an effect of immersive reality.

ECOLOGY AND EMERGENCY
Visualization of aftermaths, man-made impacts on nature, various scenarios of disaster developments and ways to manage them.

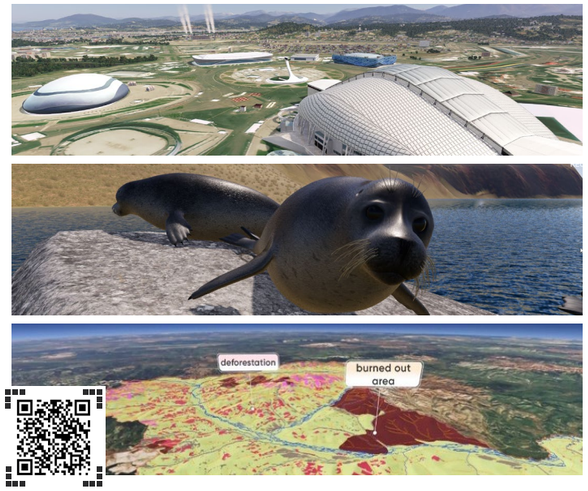
URBANISTICS
Visualization of various scenarios of urban developments, construction planning, environmental design.

TOURISM, CULTURE, ART
Development of interactive virtual trips and tours to increase tourist attraction and potential of the region.

3D GIS
Development of corporate three-dimensional geoinformational systems, VR laboratories and VR platforms on a turnkey basis.

SIMULATIONS, ENTERTAINMENT
Reproduction of a high-precision virtual environment, learning how to operate vehicles and equipment. Gaming content.

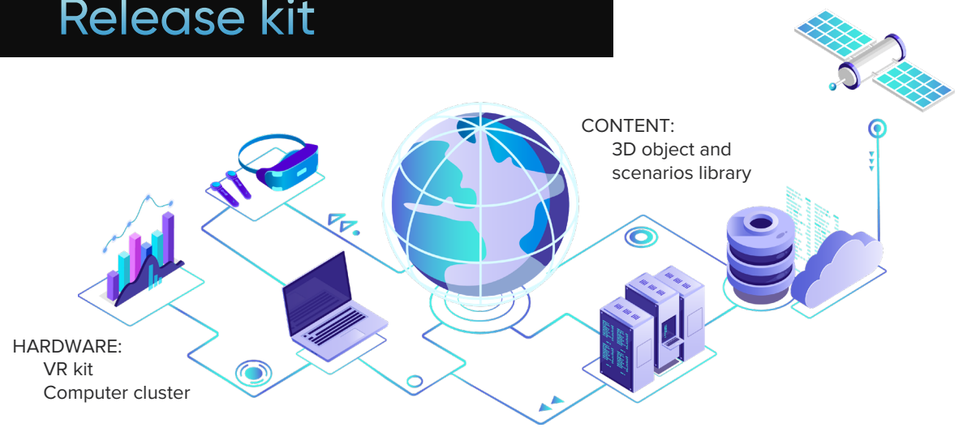
DESIGN
Effective visualization tool for developer companies during project presentation to investors or when reporting on the implementation of significant projects.



Capabilities

- virtual environment is created using space and unmanned aerial vehicles data, which makes it a reliable digital elevation model
- terrain and vegetation, objects, such as buildings, infrastructure and others, are reproduced
- automatic upload of additional images, attribute information, raster and vector layers of a customer
- simulation of emergency situations: fires, floods, hurricanes
- tools for dimensional measurements of area, distance, depth, height
- simulation of changes in objects and processes over time and space.

Release kit



HARDWARE:
VR kit
Computer cluster

CONTENT:
3D object and scenarios library

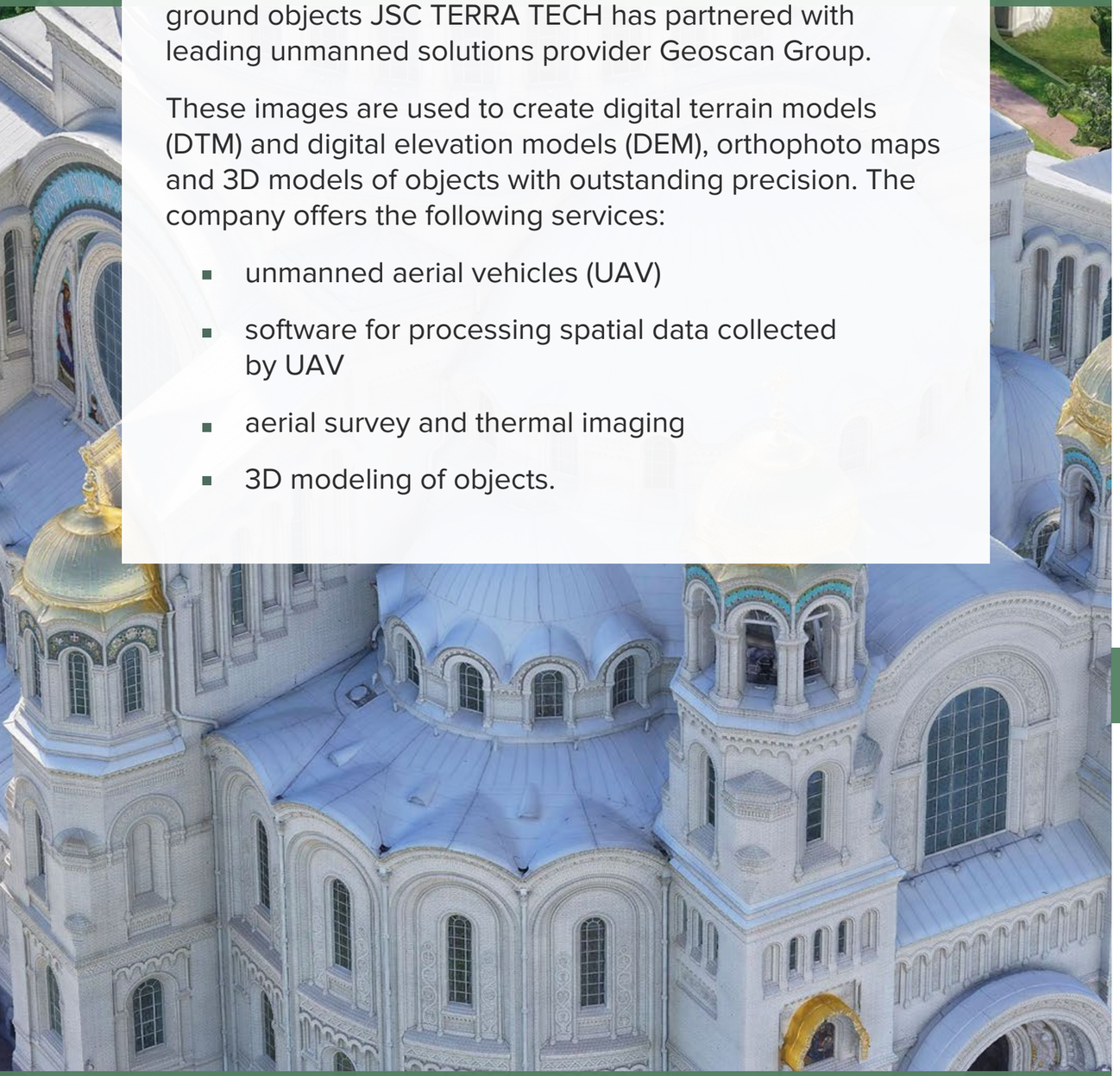
LICENSE:
Light version
Standard version
Optimum version
Professional version

AERIAL SURVEYING 3D MODELING

To deliver the most accurate digital representations of ground objects JSC TERRA TECH has partnered with leading unmanned solutions provider Geoscan Group.

These images are used to create digital terrain models (DTM) and digital elevation models (DEM), orthophoto maps and 3D models of objects with outstanding precision. The company offers the following services:

- unmanned aerial vehicles (UAV)
- software for processing spatial data collected by UAV
- aerial survey and thermal imaging
- 3D modeling of objects.



Aerial surveying

Unmanned aerial survey allows to collect spatial data of a high resolution up to several centimeters. Multi-angle surveying capability allows to obtain a detailed image of any object, which can be applied in a wide range of tasks:

- territory development planning, making of urban planning documentation
- execution of cadastral works, elimination of violations and tax base expansion
- monitoring of agricultural activities, community facilities and municipal beautification
- natural resources use monitoring.

3D-modeling

Usage of aerial survey allows to create 3D models of individual objects and entire territories in various formats for:

- assessment object conditions
- performing measurements (including volumetric measurements)
- creating interactive city websites
- designing structures and buildings
- monitoring changes.

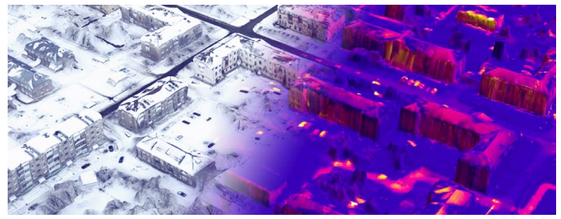
Thermal imaging

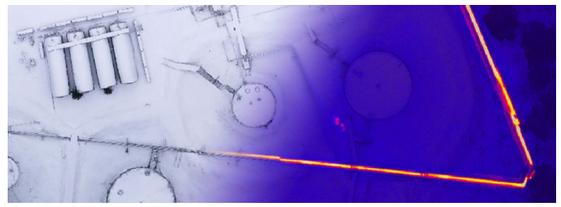
Thermal imaging is an additional method often used when building thermal maps and temperature models during aerial surveying.

The thermographic images obtained as a result of such surveying allow to reveal:

- defects in pipelines and power lines;
- heat leaks and local thermal insulation defects in buildings;
- points of discharge and leakage of waste waters.

GEOSCAN





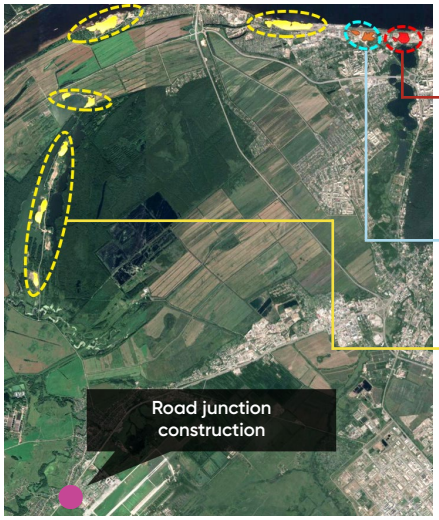
Artificial intelligence in ERS data processing

JSC TERRA TECH develops algorithms for automated recognition of various objects (buildings and structures, pits, logged lands, burnt areas, dumps and others) with the use of high- and ultra-high-resolution satellite images and employs latest IT advancements and technologies:

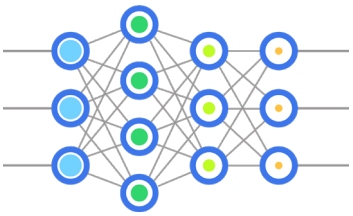
- big data
- artificial intelligence
- neural networks
- machine learning

Training and application of neural networks

Inventory of pits in the construction area

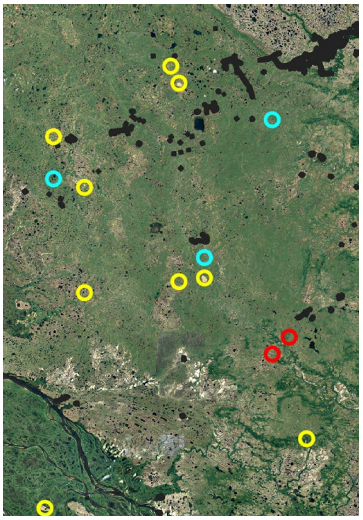


Training sample



ARTIFICIAL NEURAL NETWORK

Getting a thematic map of a pits



Machine learning algorithms based on convolutional neural networks automatically recognize objects of interest, classify them and generate information about their quantitative and qualitative characteristics.

Various neural network architectures were used to build Intelligent object recognition modules that enable automatic recognition of several groups of objects:

- pits
- buildings and structures
- forests

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