



MIIGAIAK
1779-2015



**Research and Education training centre of highly
qualified specialists in the field of application
satellite navigation technologies GLONASS/GNSS)
in Moscow State University of Geodesy and
Cartography**

Rector of the Moscow State University of Geodesy, Cartography (MIIGAIAK)

Prof. Andrey Maiorov ,

Vladimir Klimov, PhD, CEO of the Association GLONASS/GNSS Forum

Prof. MIIGAIAK, Deputy CEO of the Association GLONASS/GNSS Forum,

Andrey Kupriyanov

**United Nations/Russian Federation Workshop on the Applications Global Navigation Satellite
Systems, 18-22 May 2015, Krasnoyarsk, Russian Federation**

- **“The Moscow State University of Geodesy and Cartography education system and the global navigation satellites systems application”**

Victor Savinych, Vasily Malinnikov, Andrey Maiorov, Andrey Kupriyanov

United Nations/Moldova/United States of America Workshop on the Applications of Global Navigation Satellite Systems Chisinau, Moldova, 17-21 May 2010

- **“The Moscow Geodesy and Cartography State University (MIIGAİK) experience in educating of specialists in applications of GNSS”** Victor Savinych, Vasily Malinnikov, Andrey Maiorov, Andrey Kupriyanov

United Nations/United Arab Emirates/United States of America Workshop on the Applications of Global Navigation Satellite Systems Dubai, 16-20 January 2011

- **“GNNS/GLONASS SPECIAL APPLICATIONS AND THE PROGRAMS OF PRACTICAL TRAINING OF SPECIALISTS”** Victor Savinych, Andrey Maiorov ,
- Victor Nepoklonov, Andrey Kupriyanov
- **The Seventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG-7), 4 - 9 November 2012, Beijing, China**

“GLONASS LEARNING CENTRE”

General Director RSS, Prof. Gennadiy Raykunov
President of the University - Prof. Victor Savinych,
Rector of the University - Prof. Andrey Maiorov ,
Deputy of the Rector of the University – Prof. Victor Nepoklonov,
Prof., CEO of Association GLONASS/GNSS Forum, Andrey Kupriyanov

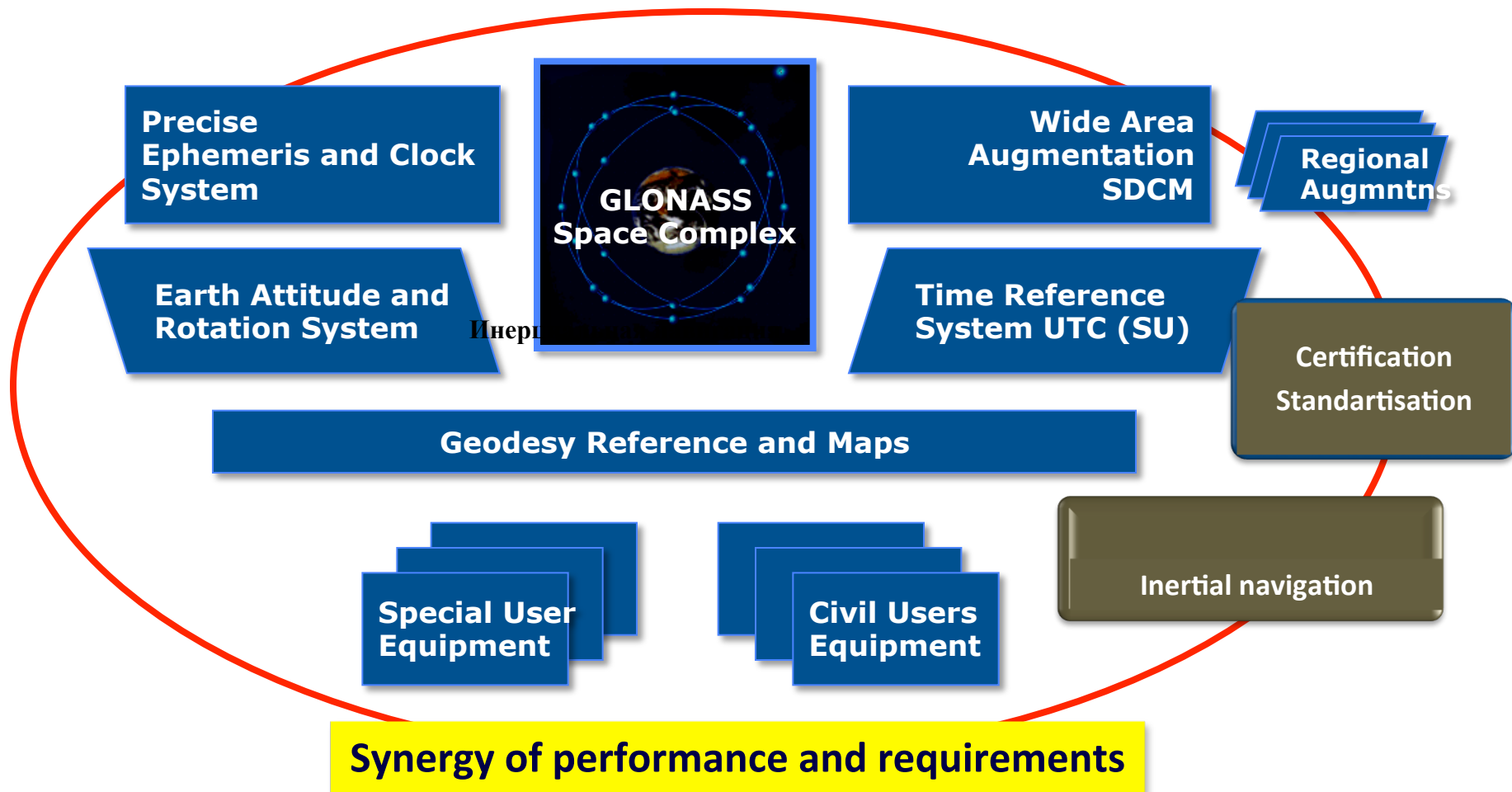
The eighth Meeting of the International Committee on Global Navigation Satellite Systems (ICG-8), 10-14 November 2013, Dubai, UAE

“THE MOSCOW STATE UNIVERSITY OF GEODESY AND CARTOGRAPHY IS THE EDUCATION CENTRE FOR GRADUATION OF INTERNATIONAL SPECIALISTS OF THE GLOBAL NAVIGATION SATELLITE SYSTEMS”

President of the MIIGAİK - Prof. Victor Savinych,
Rector of the MIIGAİK- Prof. Prof. Andrey Maiorov ,
Prof. MIIGAİK, the CEO Deputy of Association GLONASS/GNSS Forum,
Andrey Kupriyanov

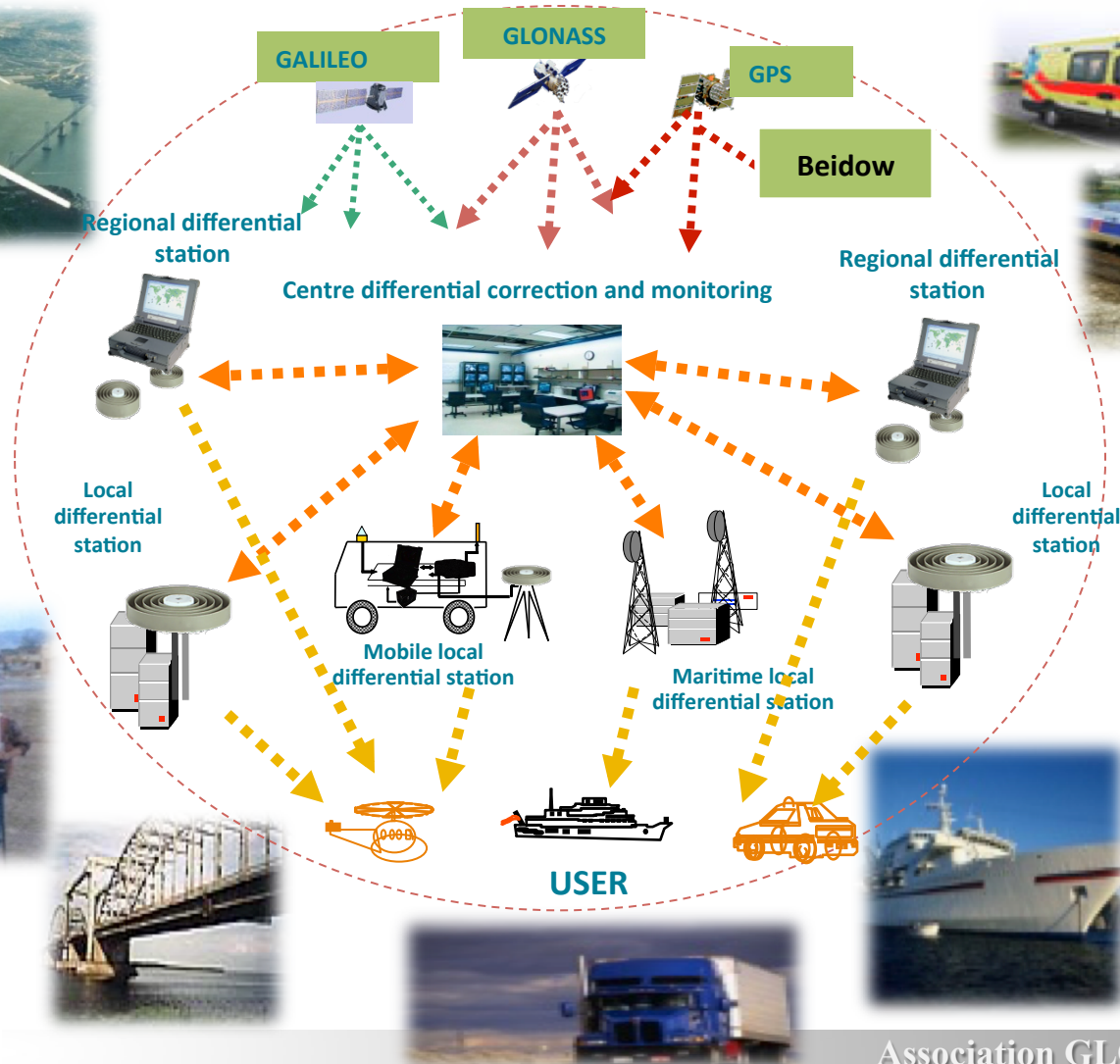
**Ninth Meeting of the International Committee on Global Navigation Satellite Systems (ICG-9),
10-14 November 2014, Prague, Czech Republic**

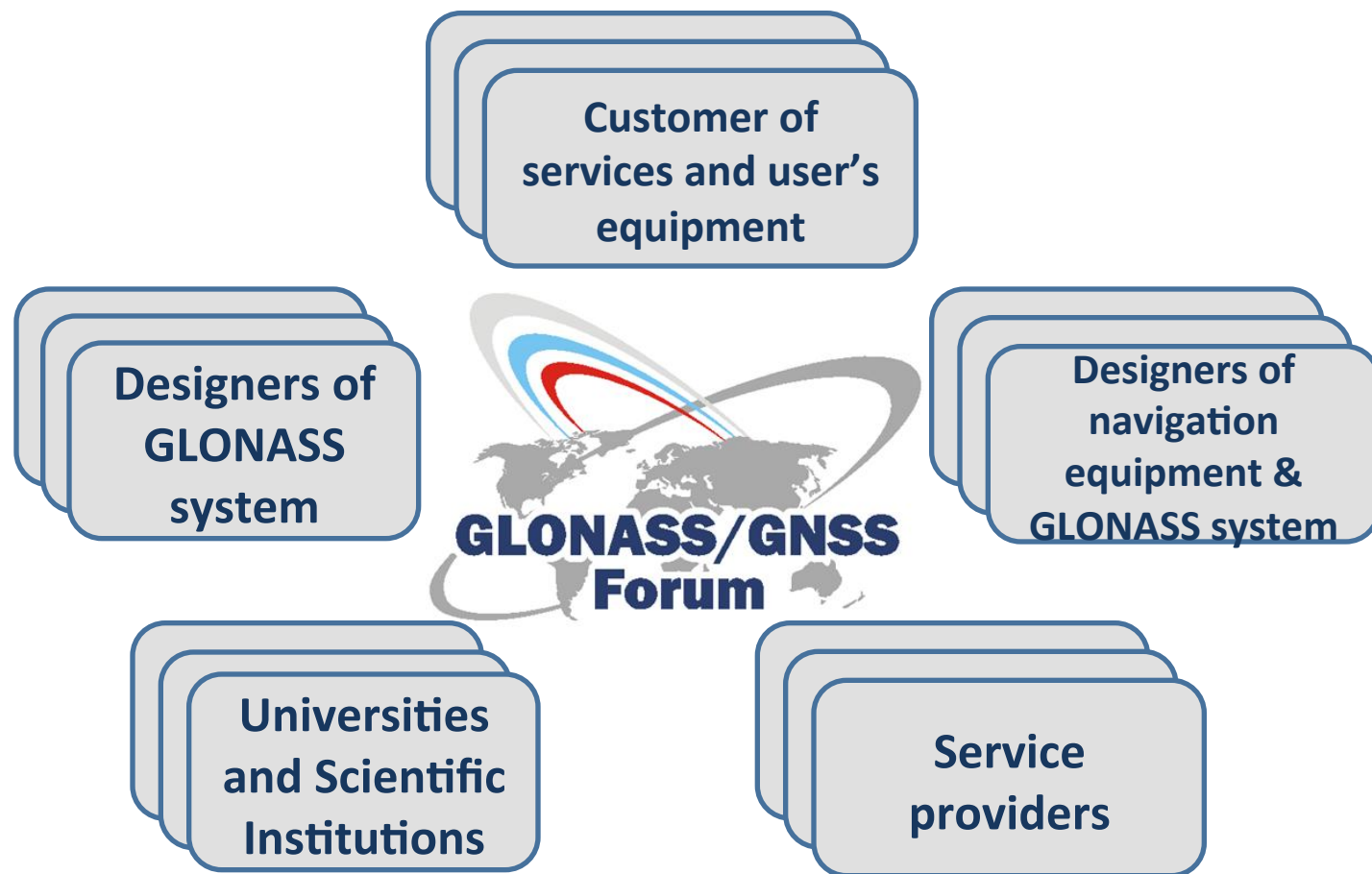
Extended PNT Architecture



The next level of mass service – precision positioning

The development of ground infrastructure of high-precision navigation system





Association unites about 80 enterprises, growth for the year

10%

Association GLONASS/GNSS – Forum

GLONASS/GNSS Forum is in cooperation with leading position organizations and universities of Russian Federation for the purpose of training and advanced training in GNSS applications.

The Moscow State University of Geodesy and Cartography is the member of GLONASS/GNSS Forum Association and developed several teaching materials for specialists in high precision applications

MIIGAiK est. 1779



Geodesy and Cartography Institutes

RUSSIAN FEDERATION-

has **two higher education institutions** geodesy and cartography profiles

- (bachelor's programme, specialisation,
- master's degree programme, graduate school, doctoral candidacy, extended education, professional development .

The **major disciplines** are:
applied geodesy, astronomy-geodesy, aerial survey, space geodesy and navigation, cartography, remote sensing, applied informatics in geodesy, land registry, cadastre, etc.

- Moscow State University of Geodesy and Cartography (**MIIGAİK**), Moscow
 - Siberian State Academy of Geodesy (**SGGA**), Novosibirsk
-
- At the present time, in MIIGAİK and SGGA are studying more than **10,000 students** and the past graduates
 - The class of graduates is more than **1000** annually.

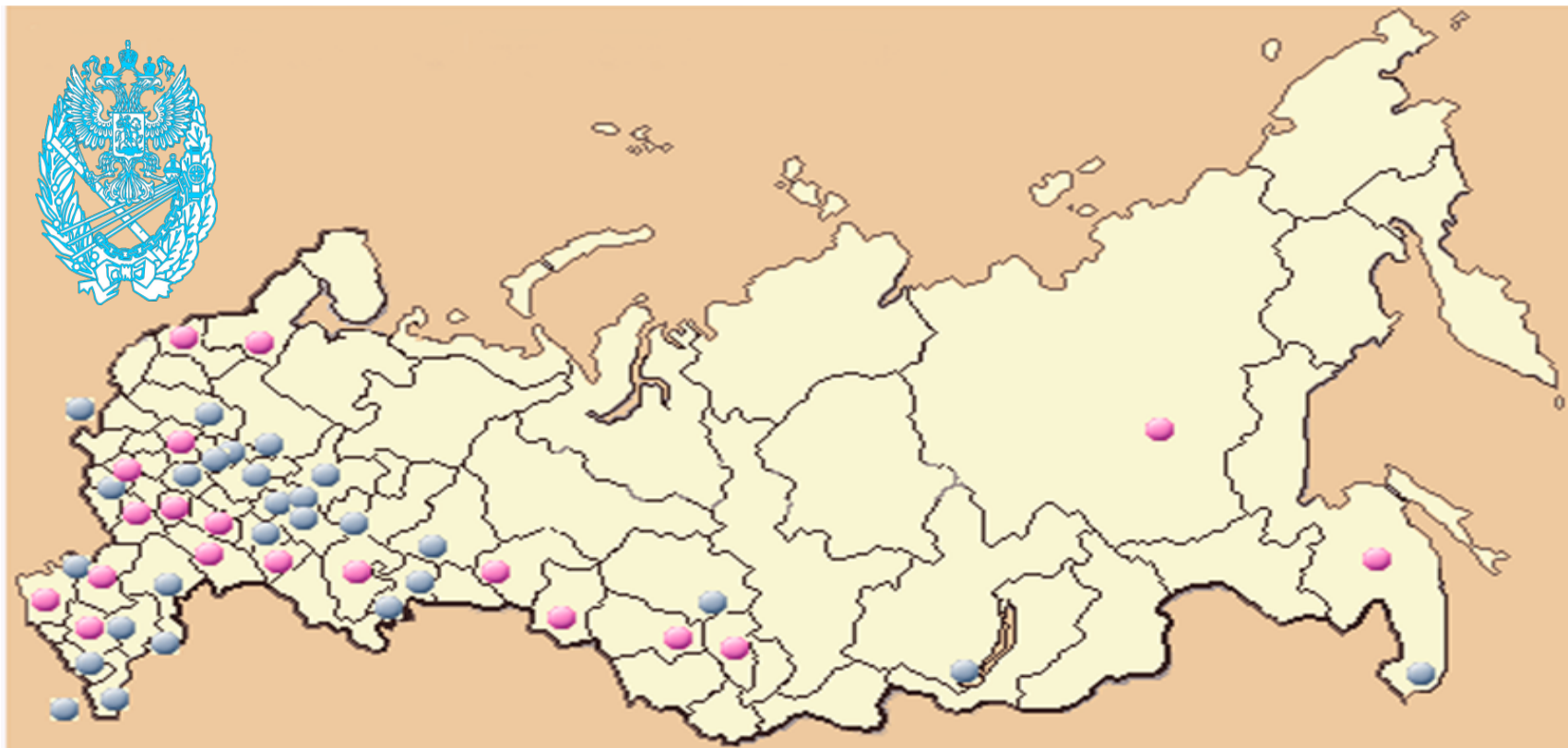
The main specialities in MIIGAIK

- **GEODESY (Applied geodesy, Astronomo-geodesy, Space geodesy)**
- **Photogrammetry and remote sensing,**
- **Aerial survey (Remote sensing and monitoring of the Earth from space)**
- **Laser equipment and laser technology**
- **Information systems and information technologies**
- **Applied informatics (in survey, in informatics systems)**
- **Management and technologies of information protection**
- **Land management and land cadastre (Municipal cadastre)**
- **Cartography**
- **Optic-electronic equipment and systems**
- **Jurisprudence**
- **Finance and credit**
- **State and municipal management**
- **Enterprise management**

The education structure of Moscow State University of Geodesy and Cartography consist on several levels:

- **Pre-higher education professionally oriented with high-school children, including distance education,**
- **Bachelor's program**
- **Specialization**
- **Master's degree program**
- **Graduate school**
- **Doctoral candidacy**
- **Extended education, Professional development**

The Educational Tutorial Association under MIIGAIK includes **24 higher education institutions** of Russian Federation



More **than 600 students** graduated at the chairs of geodesy of institutes and universities annually

MASTER'S DEGREE PROGRAM

- “GEOGESY”

GNSS technologies in geodesy, physical geodesy, geodetics methods for study of Earth geodynamic processes, the Earth gravitation study, astronomy-geodesy, space astrometry, theory of celestial mechanics, mathematical astronomy, gravitational astronomy, theory of motion of satellites and the orbit determination on base of on board measurements, geodetics applications for municipal administrations, mathematical treatment of measurements, software development, aero and space imaging, photogrammetry and phototopography, space remote sensing, charts and atlases design, graphics and revision, geoinformation technologies, cadastre, land and real estate monitoring and inventory etc.

- “OPTO-TECHNOLOGIES”

- Applied optics, Optics and Optoelectronic equipment, Laser equipment

GNSS SPECIAL COURSES

- Base course: Global Navigation Satellite Systems
- Space Geodesy
- Space Navigation
- Orbital Methods
- GNSS reference networks applications for monitoring of global, regional and local geodynamic, etc.,etc
- Survey technologies, methods and equipment on base of GNSS signals
- Monitoring of Constructions

POST-GRADUATE EDUCATION, GRADUATE SCHOOL

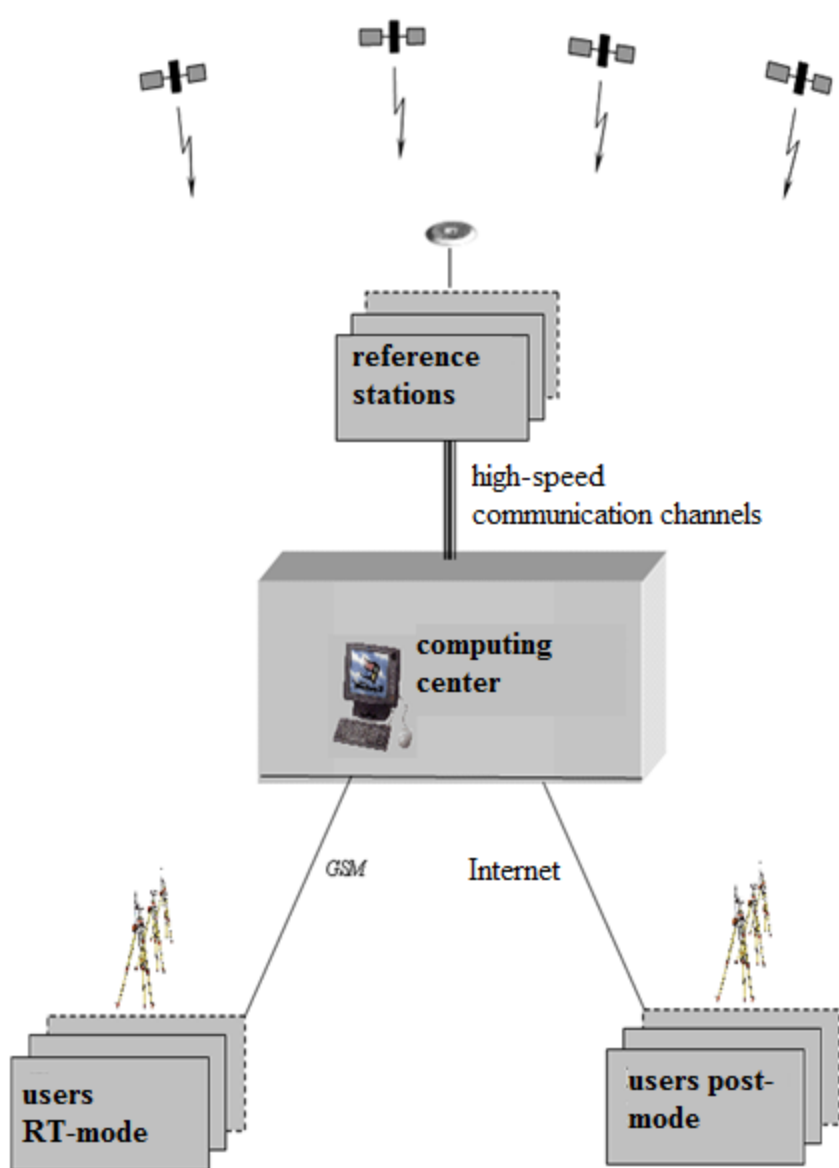
- **Geodesy (INCLUDES ALL GNSS APPLICATIONS)**
- **Cartography (INCLUDES ALL GNSS APPLICATIONS)**
- **Land management, cadastre and land monitoring (INCLUDES ALL GNSS APPLICATIONS)**
- **Aerospace research of Earth, photogrammetry (INCLUDES ALL GNSS APPLICATIONS)**
- **Geoinformatics (INCLUDES ALL GNSS APPLICATIONS)**
- **Optical and optoelectronic equipment and systems**
- **Geoecology**
- **Economy and management of nation's economy (in sectors including economy, development and management of enterprises, industry branches, complexes)**

Since the late 80s the Russian Federation has begun to apply commercial satellite equipment and technology. At the first stage it was receivers with code measurements for maritime and ground navigation, survey. Maritime and aviation application were under IMO and ICAO requirements and regulations.



Education programs in commercial application of precision technology and equipment were first of all in survey, cadastre, land and ground infrastructure inventory. The major sector of application were oil&gas, survey and mining. The methods of field applications for training courses were static, pseudo kinematic.



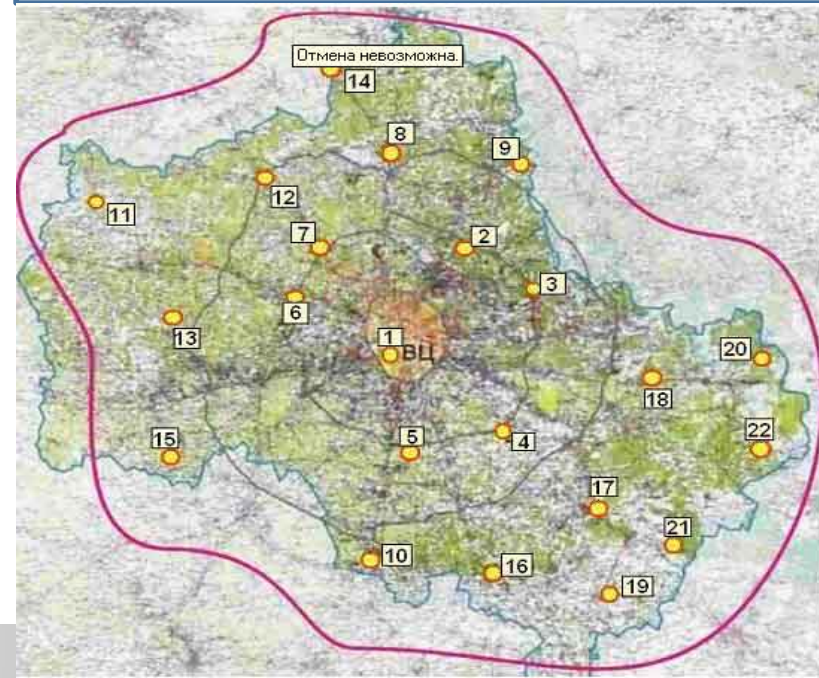


The next level of education courses was development, improvement of technology equipment for commercial application

- RTK-kinematics in real time, kinematics with moving base

base stations, transmission of differential corrections

Training courses for (regional, local) reference networks for various applications based on GLONASS/GNSS





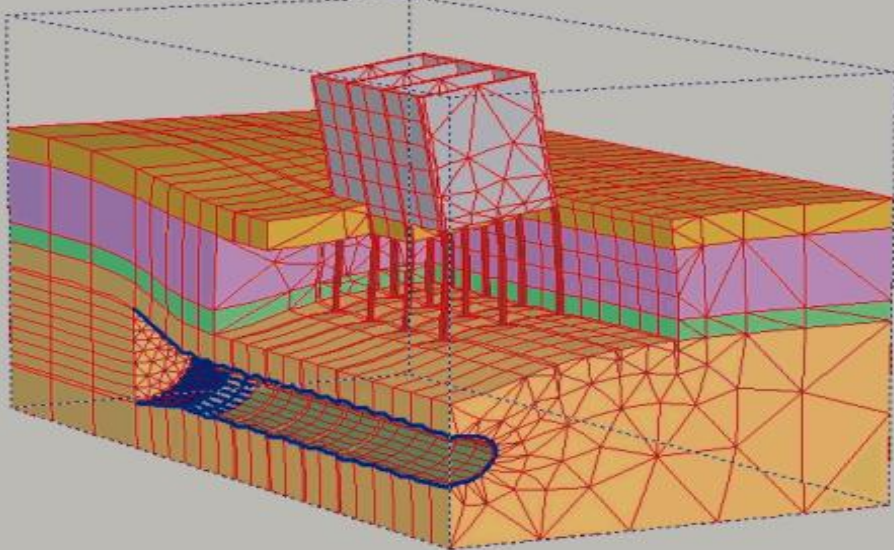
Direction courses for specialists in high-precision applications of GLONASS / GNSS technology and equipment :

-monitoring of ground infrastructures, oil and gas pipelines, geophysical survey and other work on the continental shelf

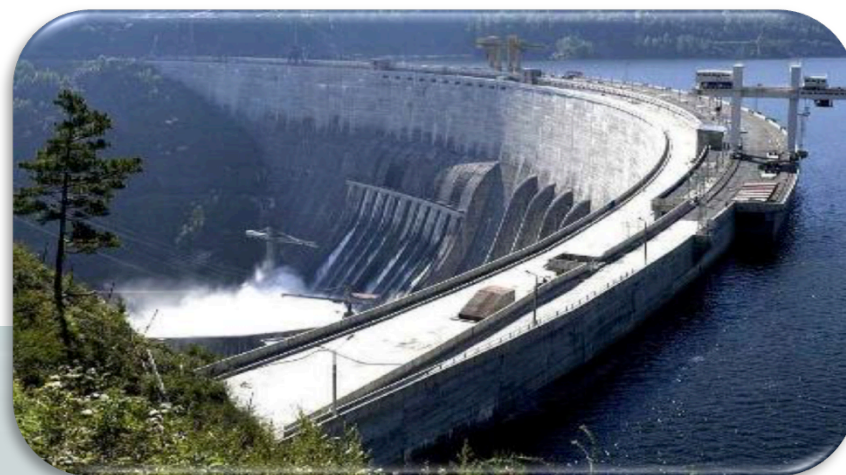


-machine control - road construction with centimeter accuracy, using technology and real-time reference stations, digital maps





GLONASS/GNSS monitoring systems of buildings, bridges, dams - Precision control system using local reference systems, data transmission systems, software analysis for decision making



Increasing Informational content coordinate and time providing rolling stock

High-precision monitoring of objects of transport infrastructure, keeping and creating united digital cartographical basis



Precision agriculture. Mining.



RTK is the main open cut mining GNSS technology

-Precision agriculture develops intensively in private sector using local differential networks, precision steering systems can now run on commercial market.



Areas of application of GLONASS

Energy resource

- **Positioning of power lines masts ;**
- **Monitoring of hydroelectric power stations;**
- **Control of transport mobile means of emergency services in real time;**
- **Tracing of power lines by means of geo information systems and technologies of aerial photography;**
- **Synchronization with help of technologies of satellite navigation.**



**Education courses developed by
MIIGAIK in accordance with
Federal “GLONASS” program
under JSC “RUSSIAN SPACE
SYSTEMS”:**

**The purpose of the education program is to
add or to implement in GNSS
general curriculum the applications courses
in accordance with the main strategic
directions - GLONASS popularization, social
economic development, different
applications of GNSS technologies and
equipment**

Working Group C: Information Dissemination and Capacity Building (WGC) held its sixth meeting in Beijing, China, on 7 and 8 November 2012 in conjunction with the Seventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG), 4 – 9 November 2012 under the chairmanship of the United Nations Office for Outer Space Affairs and China.

- **22. The Working Group C noted that the Russian Education Centre lead by the Russian Space System JSC was developing GLONASS/GNSS education infrastructure, including distance learning education courses and programmes.**
- **The work of the Moscow State University on Geodesy and Cartography (MIIGAİK) was highlighted. It was noted that**
- **these courses provided through a distance-learning degree programme could be a good resource for effectively teaching diverse learners of all disciplines at the United Nations-affiliated Regional Centres for Space Science and Technology Education.**


The each training course consist on:

- **The subject purpose;**
- **A curriculum;**
- **A syllabus;**
- **The subject glossary;**
- **The subject illustration material;**
- **A course of lectures (the theoretical material) of the subject;**
- **Questions for self-checking and keys to them;**
- **Tests for checking up the level of the subject mastering by students keys to them;**
- **A list of practice work to be done while studying the subject by students;**
- **Methodological instructions to the course paper;**
- **Methodological instructions for the teacher.**

Education courses developed by MIIGAik under JSC “Russian Space Systems”:

There are the following training courses developed :

- 1. “The fundamentals of satellite navigation”**
- 2 “Application of satellite navigation to cadastral and land planning work”**
- 3 “Application of satellite navigation to state geodetic networks”**
- 4 “The organization and planning of field operations while making cadastral surveys with the use of the GNSS, GLONASS”**

- 
- 5. “ Application of satellite technologies in earthquake regions”**
 - 6. “Application of satellite navigation to railroad and VTS”**
 - 7. “Application of satellite navigation to monitoring building structures deformations”**

8. "The Structure of satellite-based geodetic networks"

9. "GNSS (GLONASS) application for global, regional and local geodynamics"

10. "Metrological aspects GNSS (GLONASS) equipment applications."

11. "GNSS (GLONASS) technologies for the inventory of real estate lands and objects."

12. "GNSS (GLONASS) technologies for monitoring of transport infrastructure objects, the procedure for keeping and making a digital cartographic basis"

Training courses to be developed in MIIGAiK

- 13. “GNSS (GLONASS) technologies for making of digital navigation charts”**
- 14. “GNSS (GLONASS) application to topographic surveying and monitoring linear constructions (oil- and gas pipelines, power transmission lines)”**
- 15. “GNSS (GLONASS) technologies and equipment in making underground metro lines, underground constructions, tunnels”**

Laboratory practice work to be developed

The general laboratory practice work "The GLONASS (GNSS) application in geodesy and cartography" includes:

A simulation part that will allow the students to simulate operations under the conditions difficult to be reproduced in an educational class-room or distance learning system

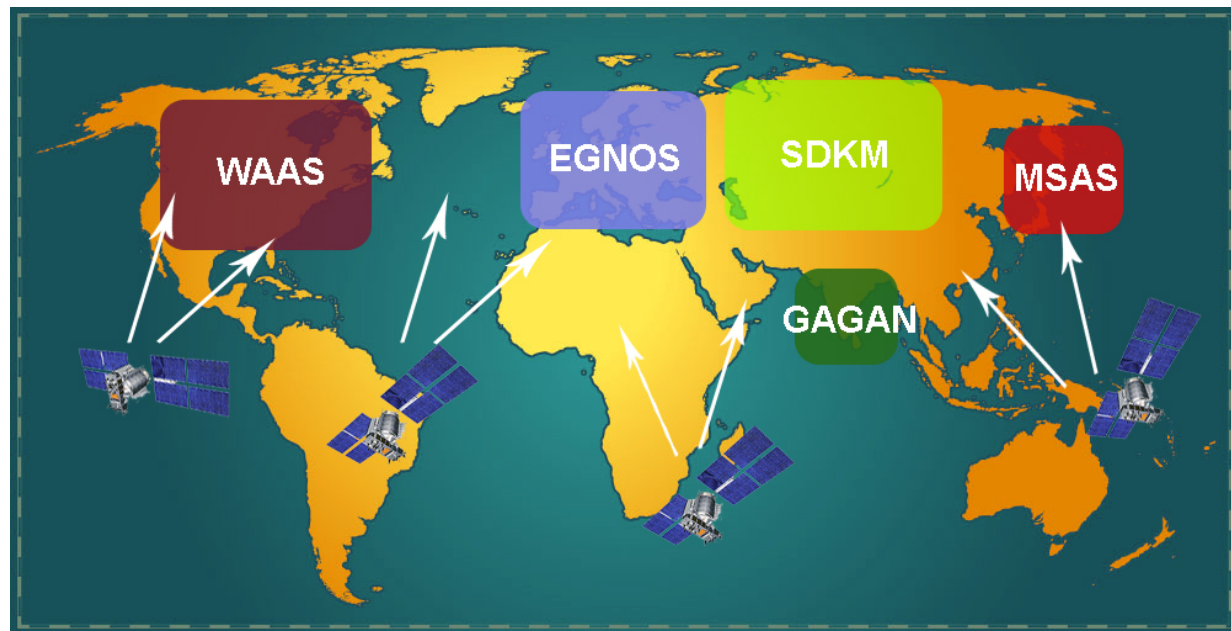
The hardware that will allow the students to conduct operations on real –life equipment in field operation

GNSS education programs are parts of

- **University Education**
- **Extended education**
- **Professional development**
- **Training courses**
- **Distance learning**
- **Senior management and administration education**



The training course “The GNSS, GLONASS BASE COURSE”



- The purposes of the course are to give general knowledge on the GNSS main segments: the theory of coordinate determination, satellite constellations, signals structure, equipment, market segments of on the GNSS application. Practical application of satellite systems, to acquaint students with approaches and technologies of application of satellite navigation.

The training course «THE FUNDAMENTALS OF GNSS (GLONASS) APPLICATION TO RAILROAD SYSTEM AND VTS»



- **The Course Purpose is to give general knowledge on the GNSS application to railway and motor transports.**
- **Practical application knowledge of satellite systems to transport.**
- **To acquaint students with approaches and technologies of application of satellite navigation to railway and motor transports.**

After studying the course the students should get general ideas of the state-of-the-art situation and main directions of application of satellite navigation systems to various kinds of transport.

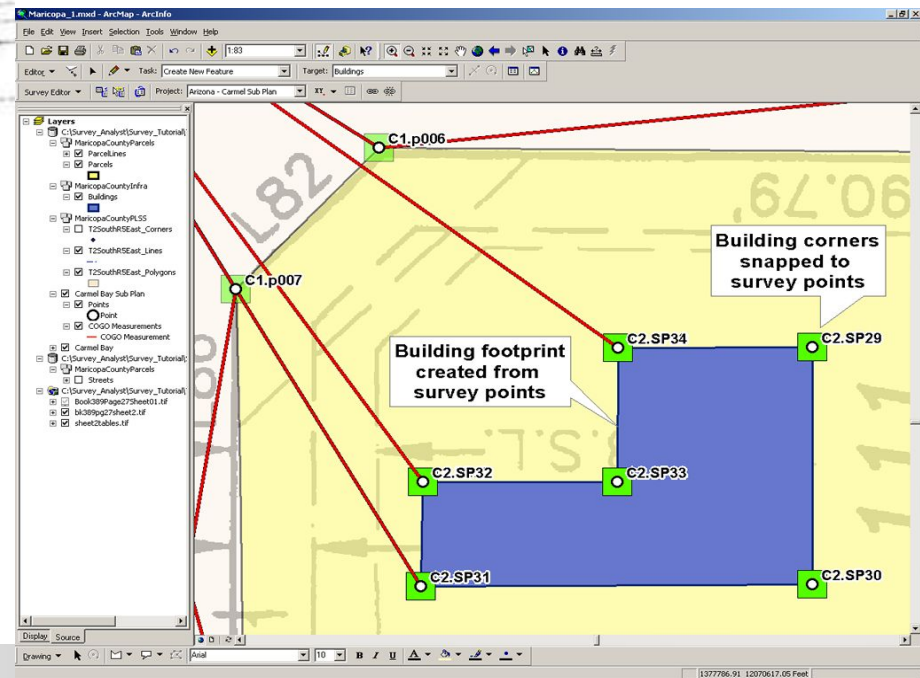


The training course «GNSS (GLONASS) TECHNOLOGIES AND EQUIPMENT FOR CADASTRE AND LAND MANAGEMENT SPECIALISTS»

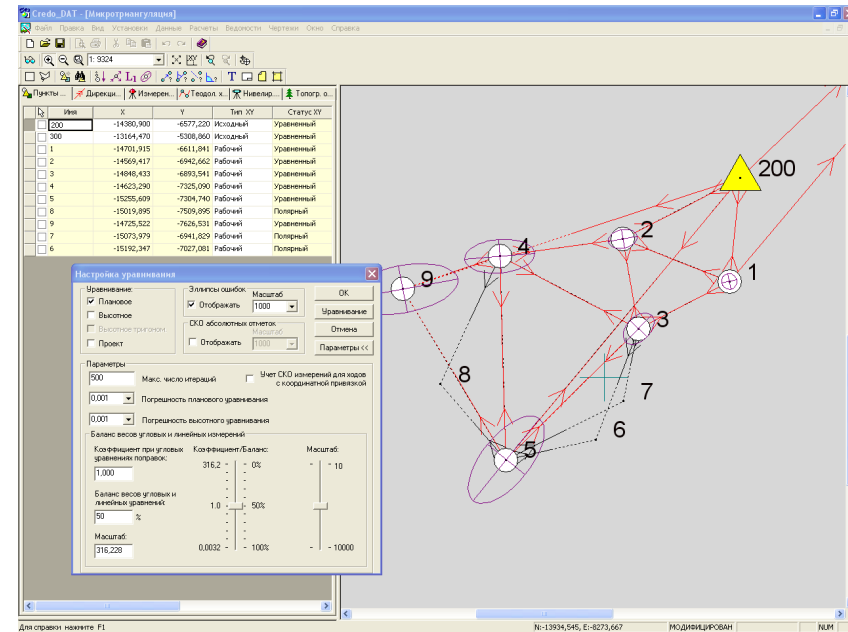
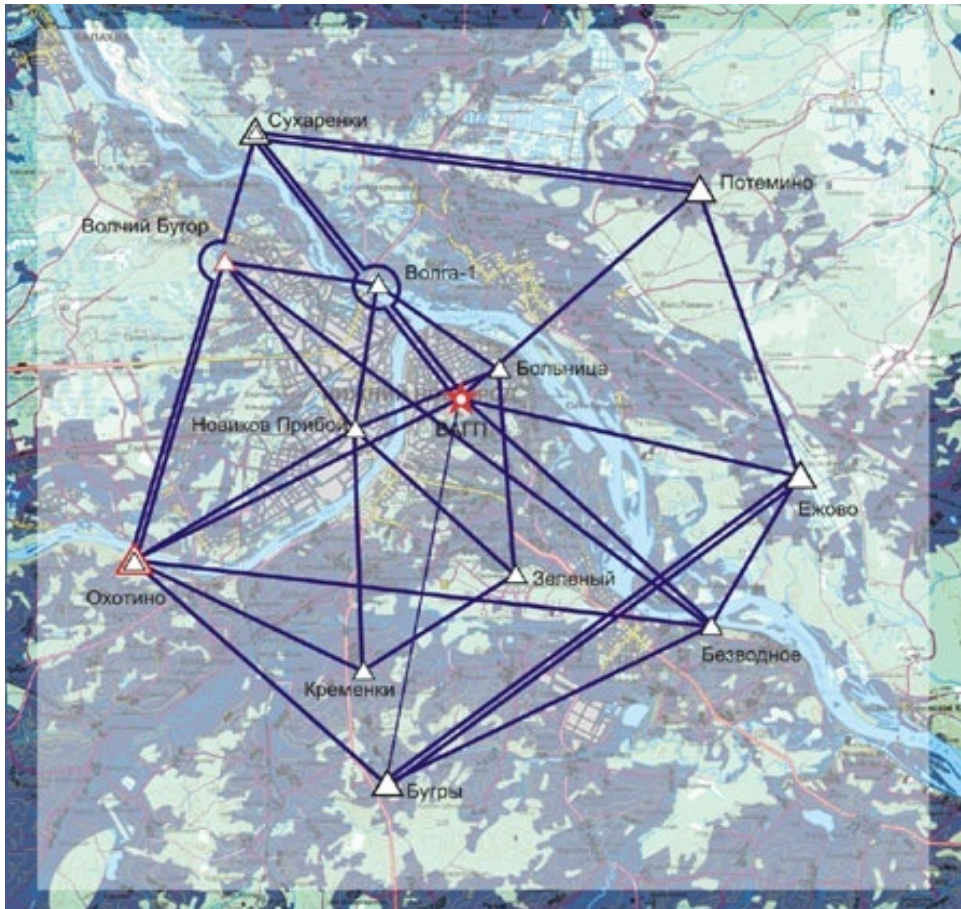
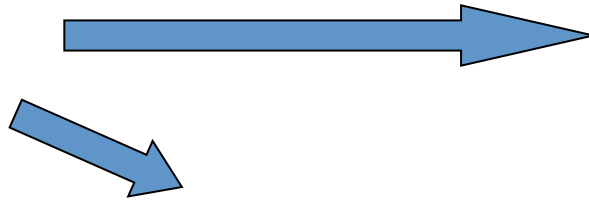
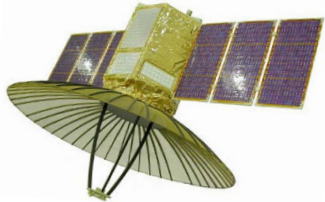


- **Training of cadastre and land use specialists with knowledge of technologies of satellite-based geodetic measurements.**

- **Acquaintance of the students with GNSS technologies of defining coordinates with GPS-Glonass satellite receivers (single and dual frequencies).Processing, analyzing and estimating the accuracy of the results obtained for cadastre and land and real estate management.**

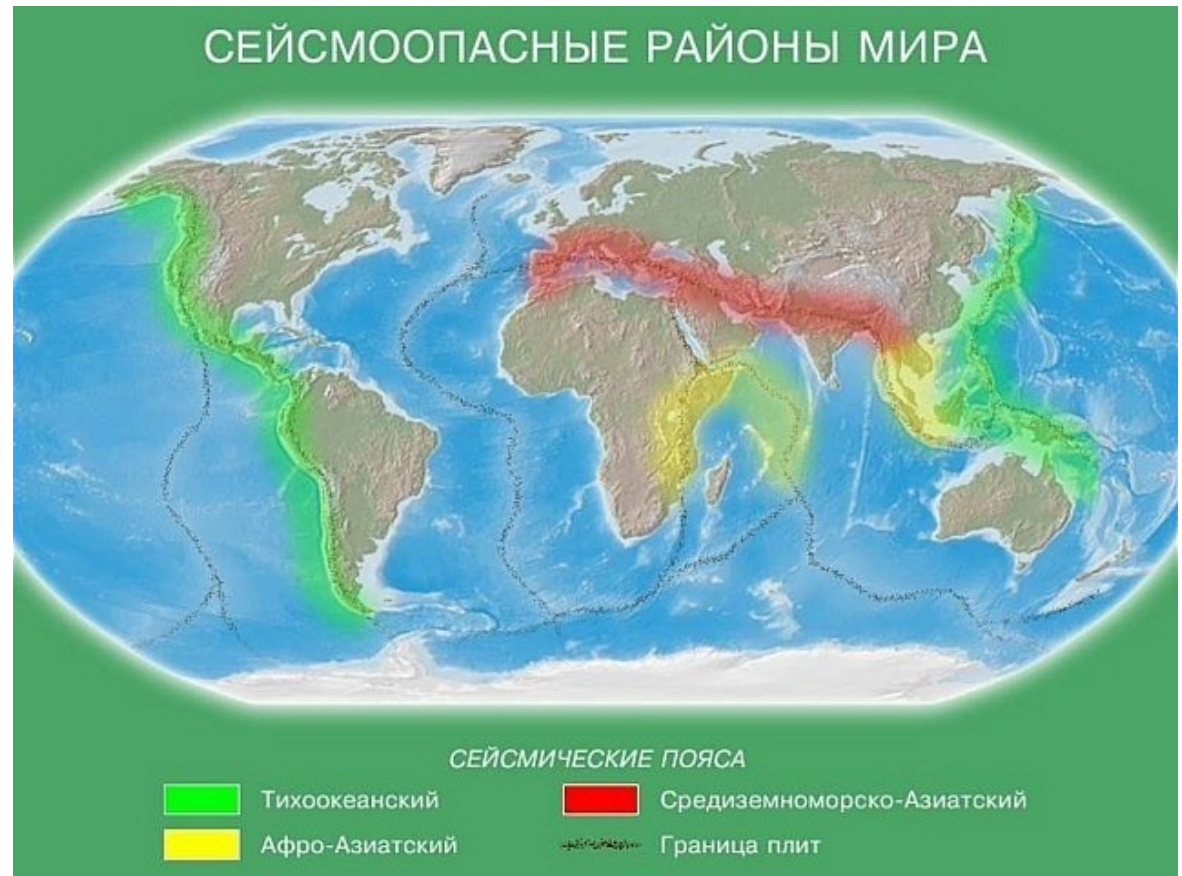


The training course «GNSS (GLONASS) APPLICATION FOR STATE REFERENCE NETWORKS»



- Students will have practical knowledge in technical design, optimization of network structure, equipment and software of GNSS used in state reference networks.

The training course «THE GNSS (GLONASS) APPLICATION IN EARTHQUAKE REGIONS»

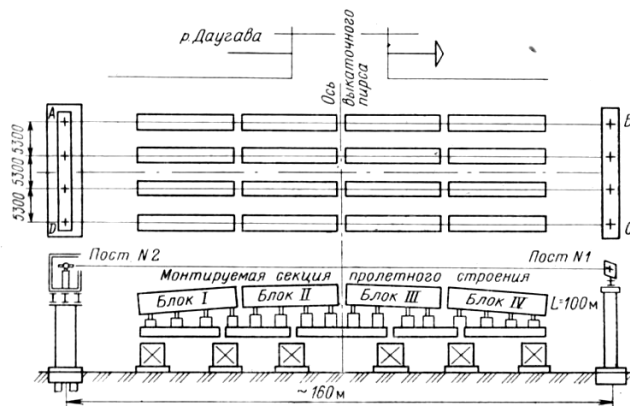


After the Course the students will have basic skills in modern methods for observing the motions and strains of the Earth's surface in seismoactive regions with the use of global navigation satellite systems.

The training course «GNSS APPLICATIONS FOR CONSTRUCTIONS DEFORMATION»



HIGH-RISE BUILDINGS



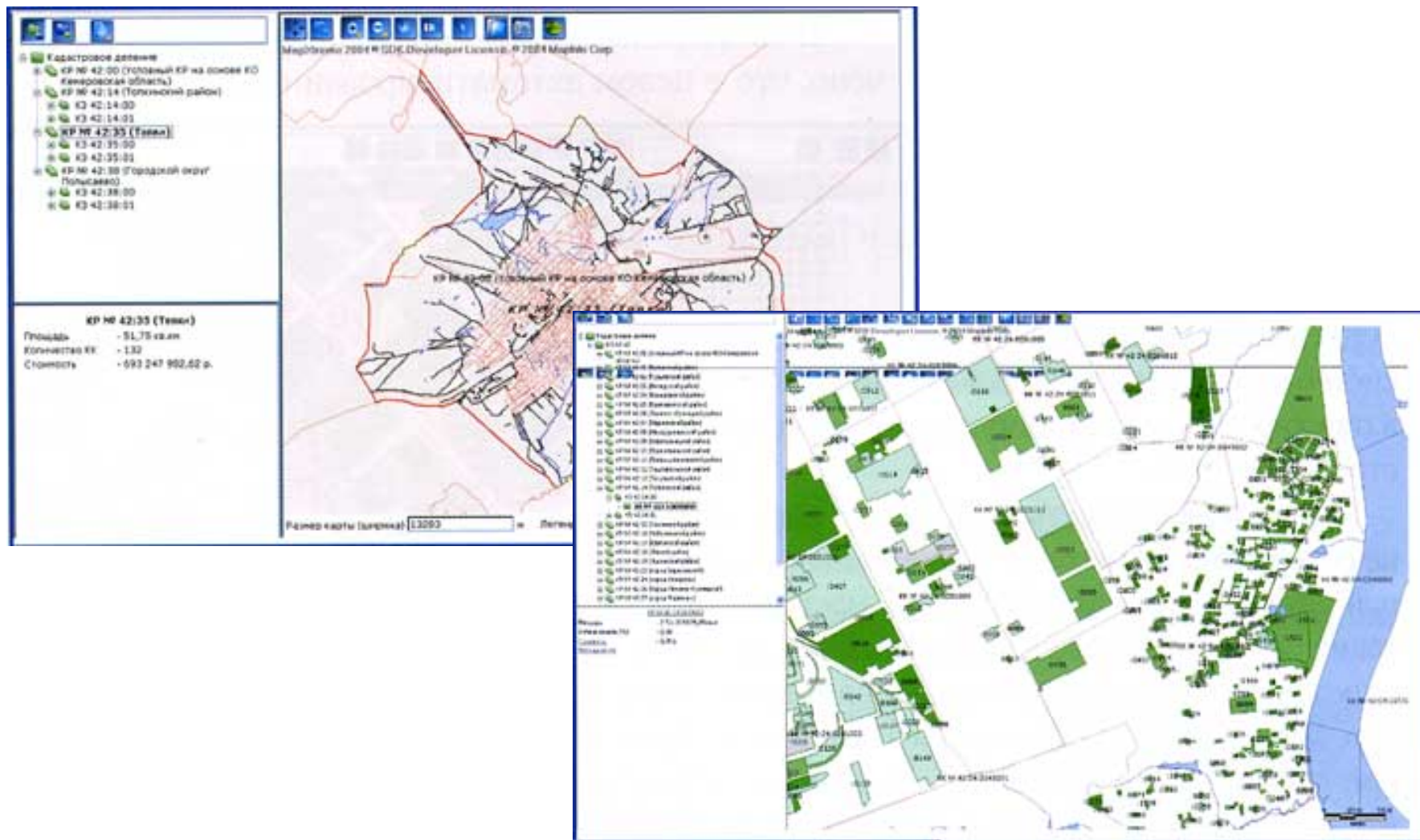
BRIDGES



DAMS

As result, student will have knowledge in equipment operation, software, technologies of monitoring of different types of engineering constructions with GNSS technologies.

The training course « FIED SURVEY MANAGEMENT AND PLANNING OF CADASTRE WITH GNSS (GLONASS)»



Real time kinematics



The System of the context help and analysis of the student's activities

Увеличено минимально необходимое время измерений на точке tr1, в связи с отсутствием синхронных измерений на базовом приёмнике.

Загружены исходные данные. Нажав на точку на карте, вы сможете задать её точные координаты.

Для того, чтобы позже успешно обработать данные, запустите сбор данных на текущей точке стояния, нажав "Tag new site"

На вкладке "Survey" собраны команды для проведения измерений. Выберите "Log raw GPS" для сбора данных в режимах "Статика" и "Stop&Go" или команду "Store points" для RTK измерений.

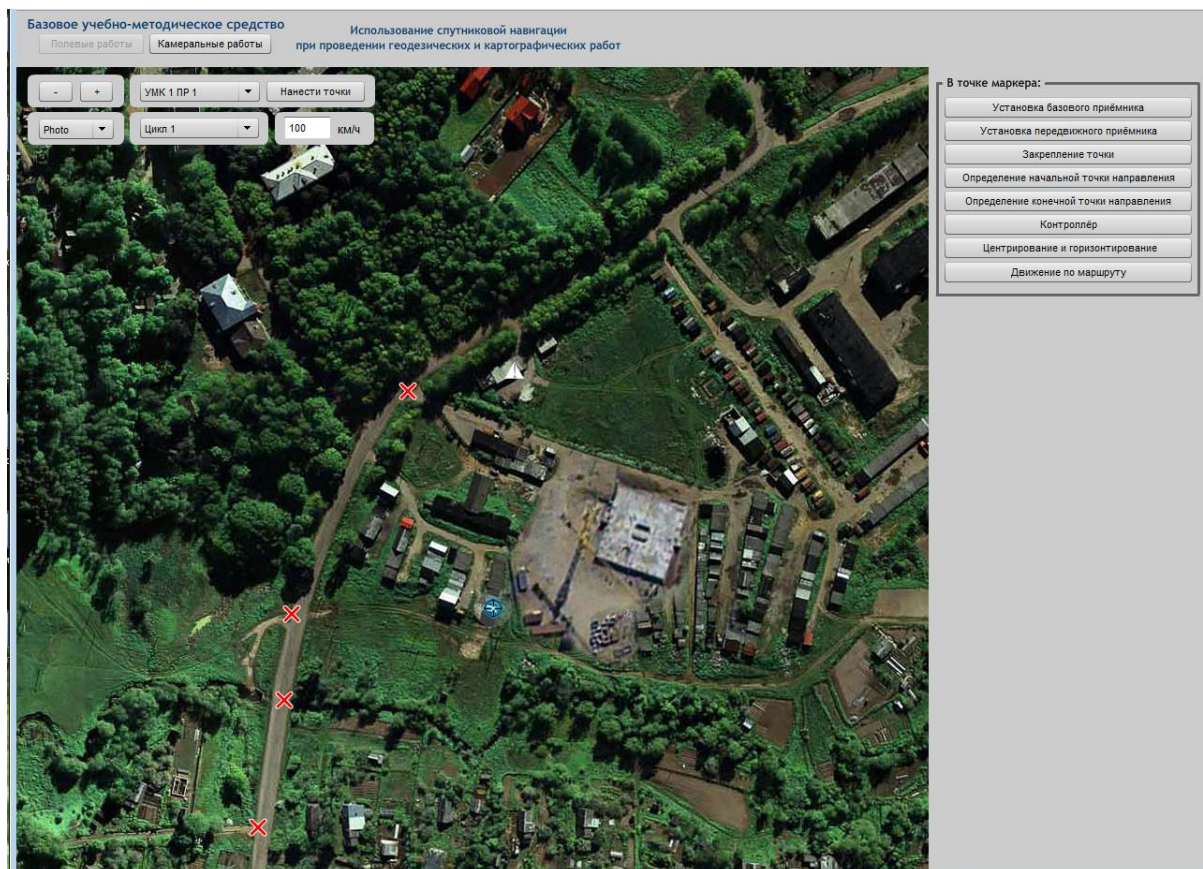


Students and post-graduates practice

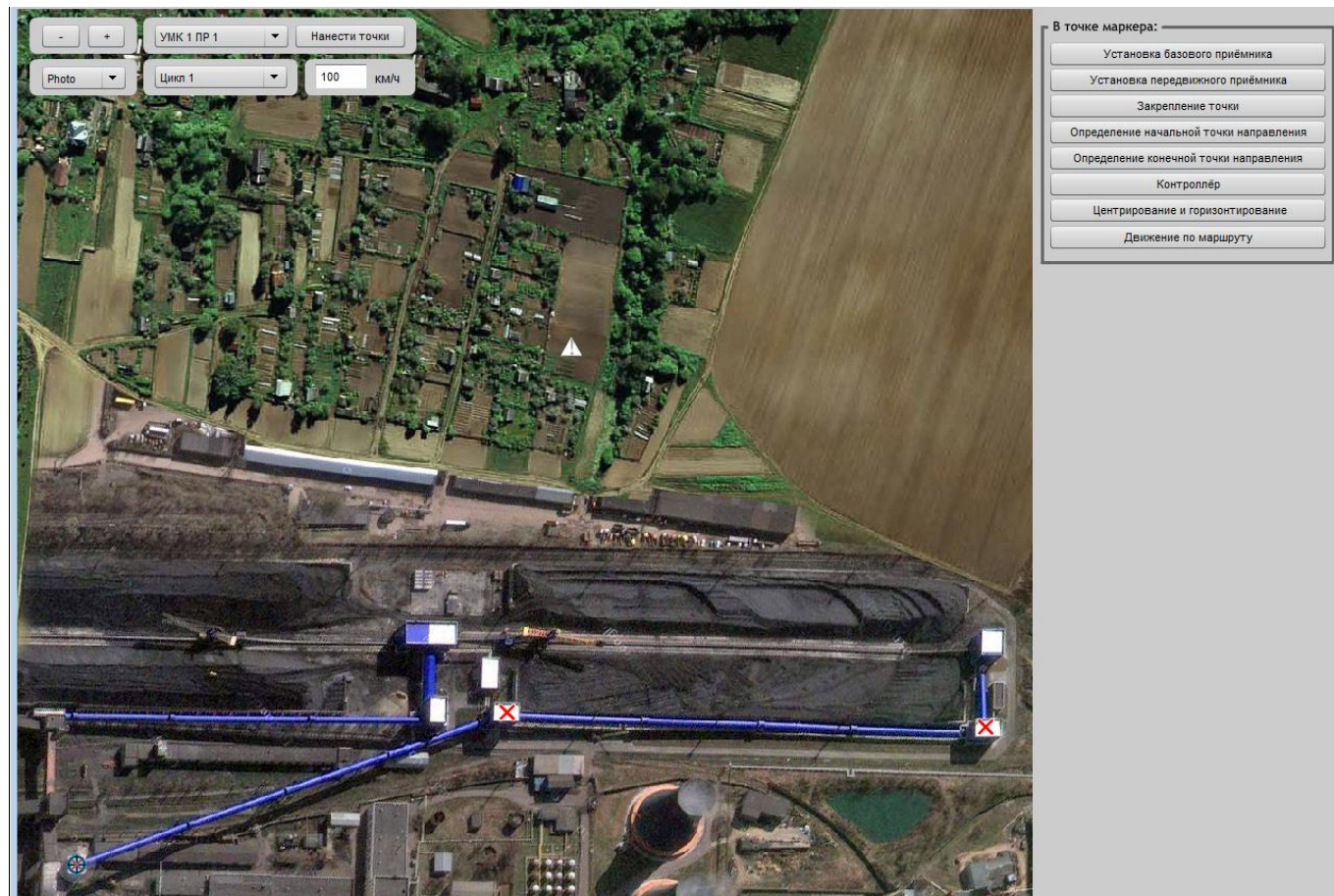




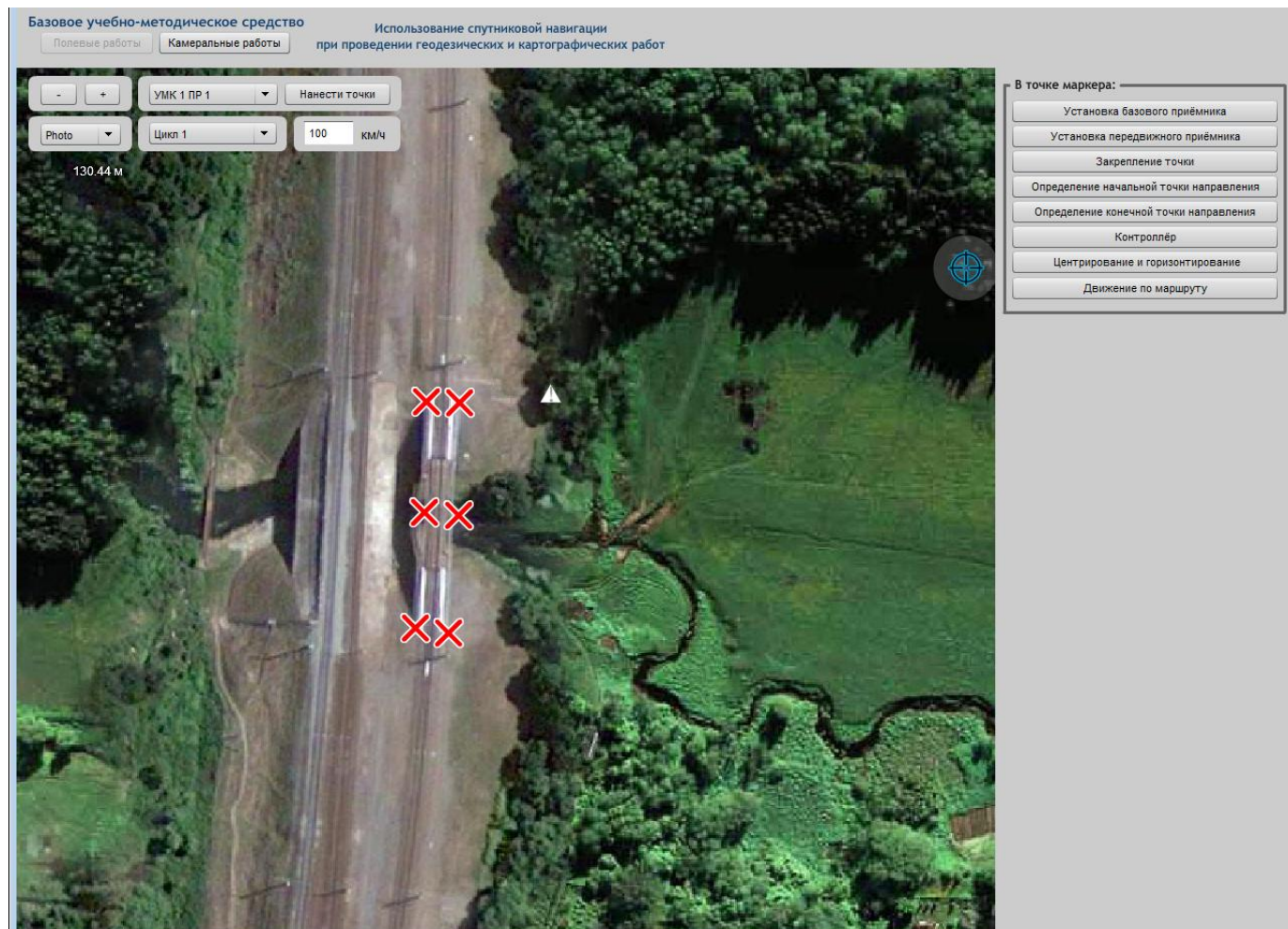
The example of the part of Road Mapping training course of field application GLONASS-GPS equipment



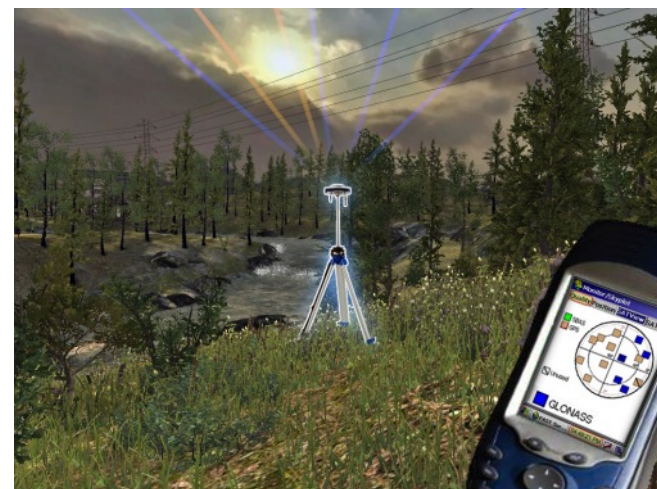
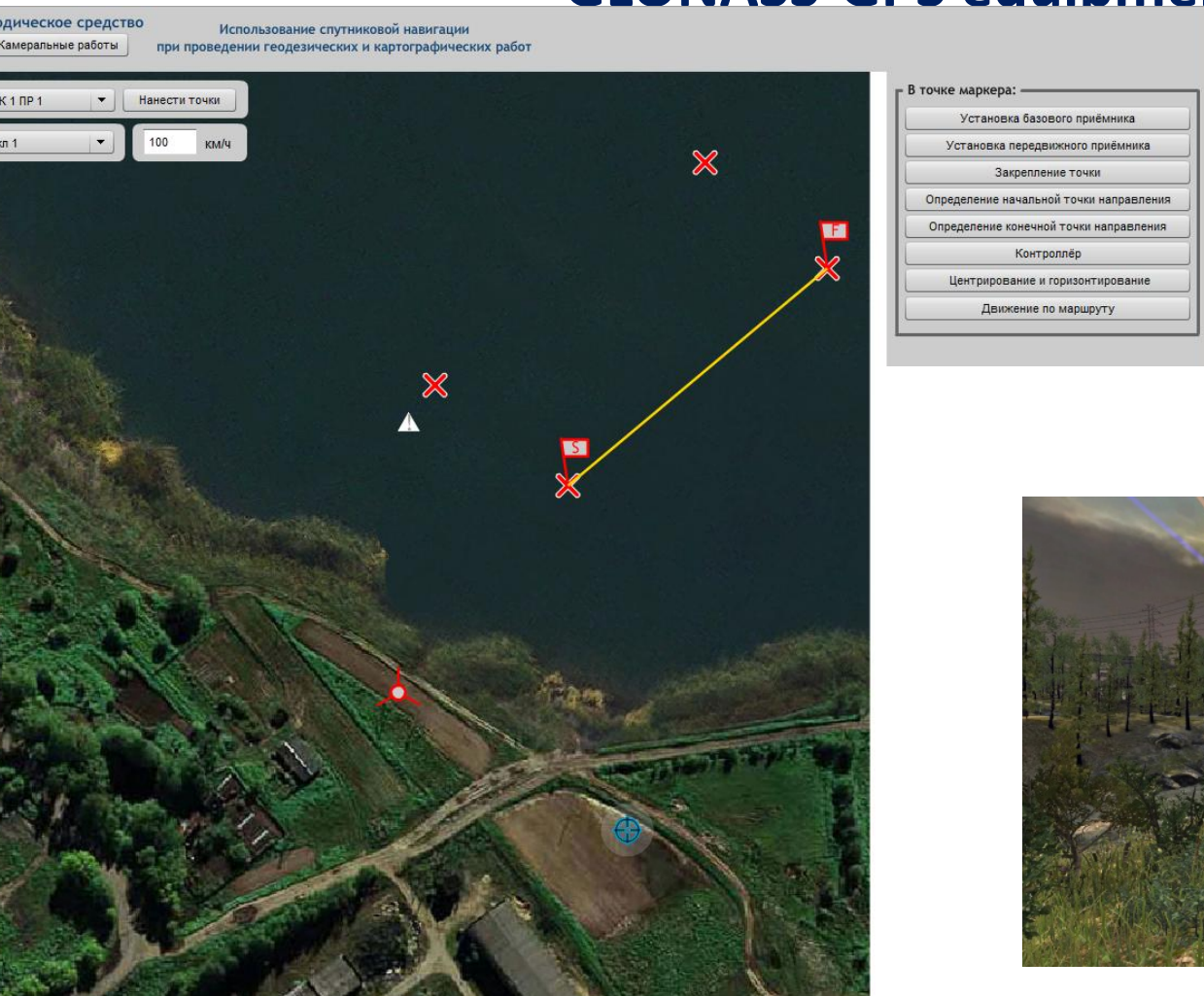
The example of the part of Oil&Gas Pipeline Monitoring training course of field application GLONASS-GPS equipment



Deformations of Constructions training course of field application GLONASS-GPS equipment



The example of the part of GNSS-GLONASS shelf zone, offshore mining, drilling training course of field application GLONASS-GPS equipment .



The “GLONASS –EDUCATION” could be the integrated part of international program GNSS application training and continuing education of specialists in different brunches of economy

Diffident countries – providers of GNSS, created education process and retraining programs on base of geographical location, economy characteristics, mining of natural recourses, oil&gas transportation, transport infrastructure, precision agreculture, machine control etc.,etc

**... and many others will:
accelerate GNSS information drive
make contribution to International GNSS society push
forward development new education courses for training
specialists in deformation monitoring, homeland security,
precision agriculture, transportation, ITS, survey,
construction,... mass introduction of GNSS/GLONASS-GPS-
BEIDOW-GALILIO navigation technologies for social and
economic benefit**

Спасибо за внимание!

THANK YOU!



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