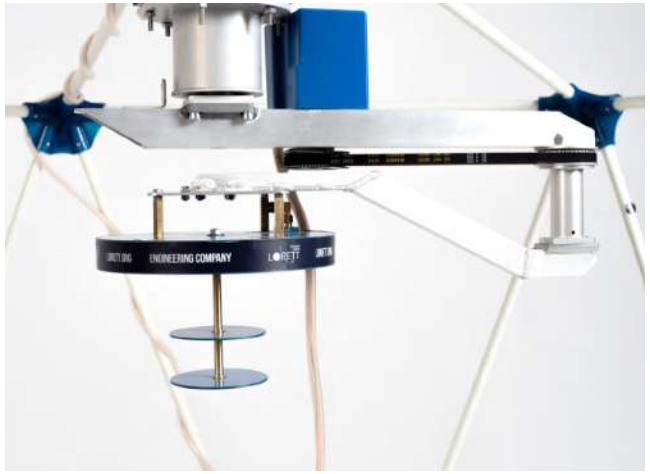
LoReTT Products and Projects Overview



About us

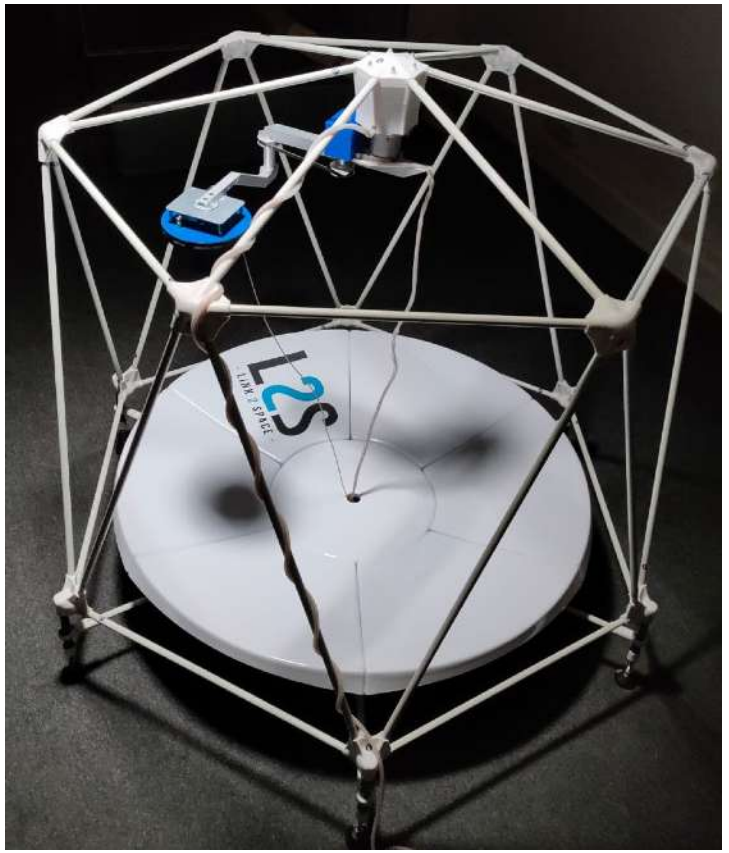
"LoReTT" company carries out activities in the field of ground-based space systems engineering and work with space images and geospatial data.

- "LoReTT" LLC was founded in April 2017 with participation of Internet Initiatives Development Foundation (IIDF).
- Since 23 March, 2018 "LoReTT" LLC is the resident of "Skolkovo" Innovation Center.
- The company's projects are supported by the Innovation Promotion Fund.

The founders and employees of the company have almost 30 years of experience in the field of creating technologies for receiving, processing and using images of the Earth from Space.

Mission: simplify and speed up access to satellite data; and reduce the cost of receiving data from satellites in real time.

LoReTT = Local Real Time Tool



Research is carried out with grant support from the Skolkovo Foundation

Dr. Vladimir Gershenzon and Mrs. Olga Gershenzon are Co-founders of the company and developers of LoReTT technology, experts in the Earth remote sensing systems and their applications.

Our experience:

Multidisciplinary cluster «Space for life on the Earth»

SILYBUM
Ground Station for the Earth observation

PLANUM
Planar station for receiving space information

PLANUM
Engineering constructor

LINK2SPACE
Engineering constructor

MOPS
Engineering constructor

COPTER4SPACE
Engineering constructor

LEX
Complex-constructor

Measuring stand

3 labs:

- **Ground Space Systems Engineering Laboratory**
- **Satellite Meteorology Laboratory**
- **Operational satellite monitoring laboratory**

Map of LoReTT equipment supplies

Anapa
Arkhangelsk
Veliky Novgorod
Dolgoprudny
Ekaterinburg

Ingushetia
Innopolis
Irkutsk
Kaliningrad
Kaluga

Kemerovo
Kirov
Korolev
Kostroma
Moscow

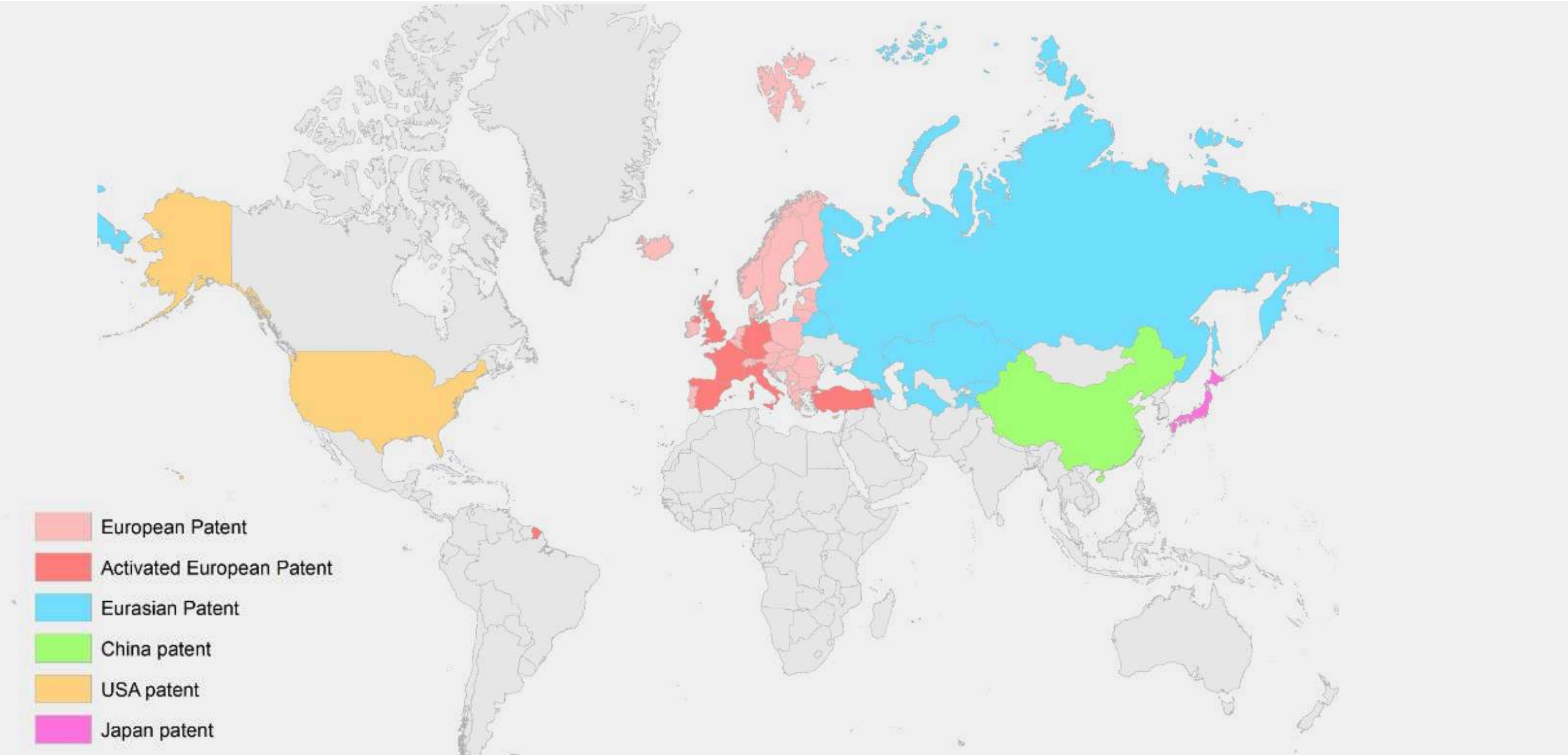
Nizhny Novgorod
Norilsk
Noyabrsk
Permian
Petropavlovsk-Kamchatsky

Pskov
St. Petersburg
Sevastopol
Smolensk
Surgut

Tyva
Ulan-Ude
Ufa
Chelyabinsk
Chita

Yuzhno-Sakhalinsk
Yakutia (Chapaevo)
Yaroslavl

Countries where the patent is registered



Silybum

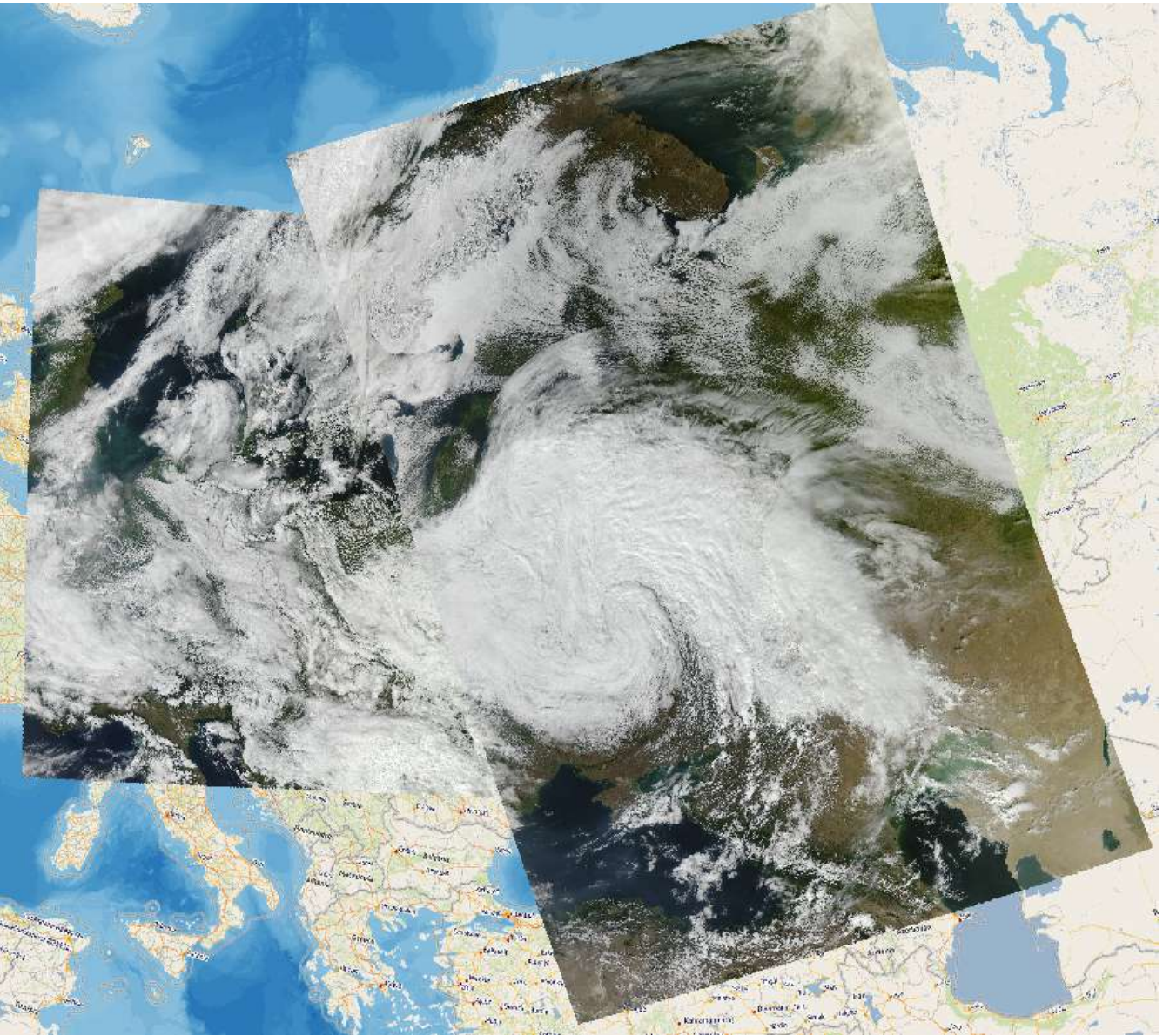
X-BAND GROUND STATION FOR REMOTE SENSING OF THE EARTH

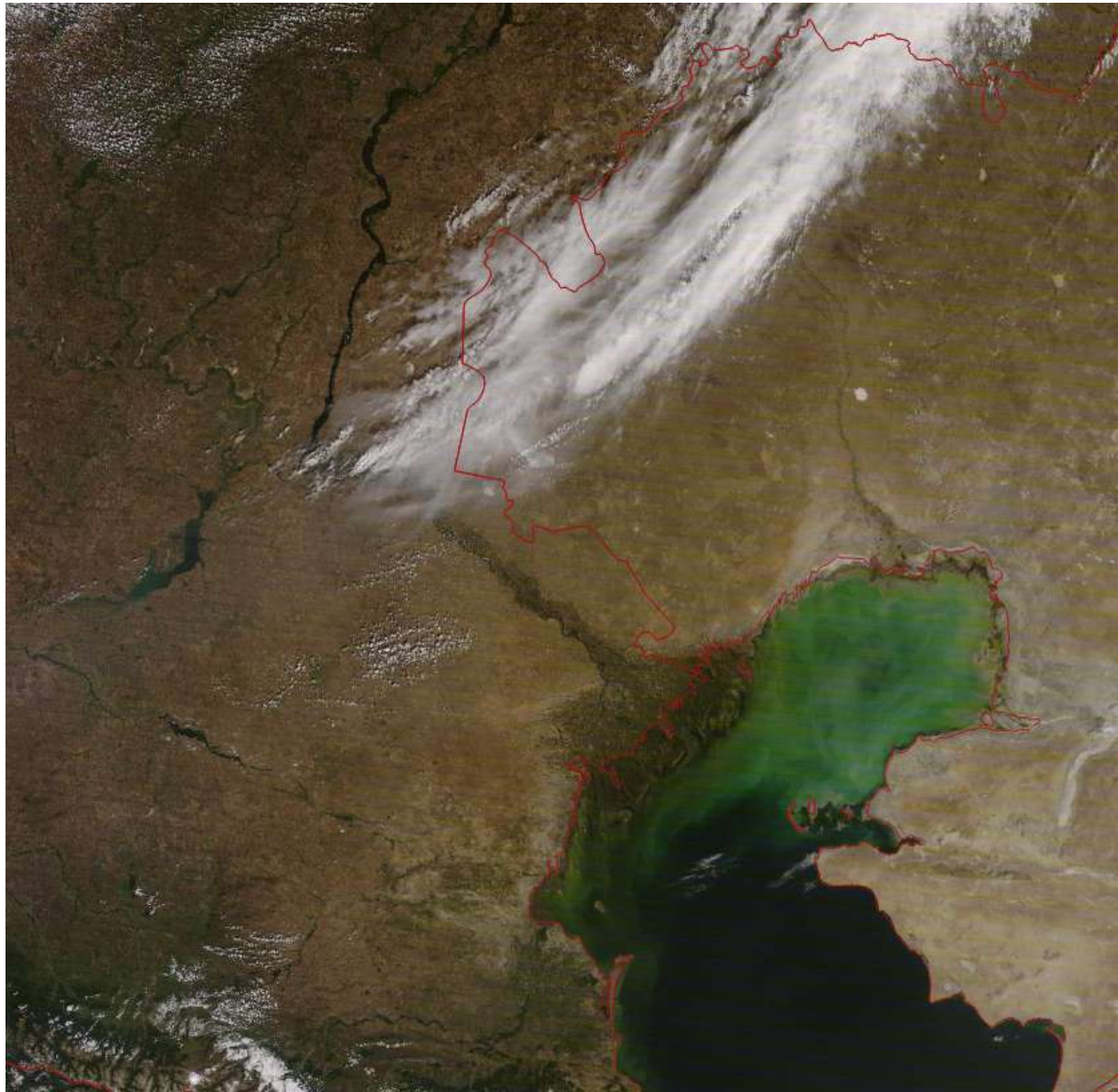
Professional receiving station "Silybum" is designed to receive and process digital information transmitted from Earth observation satellites located in low Earth orbits (LEO) via radio channels in the X-frequency range (7.8-8.4 GHz) in the signal rate range 0.1-100 Mbaud (option 0.2– 350 Mbaud).

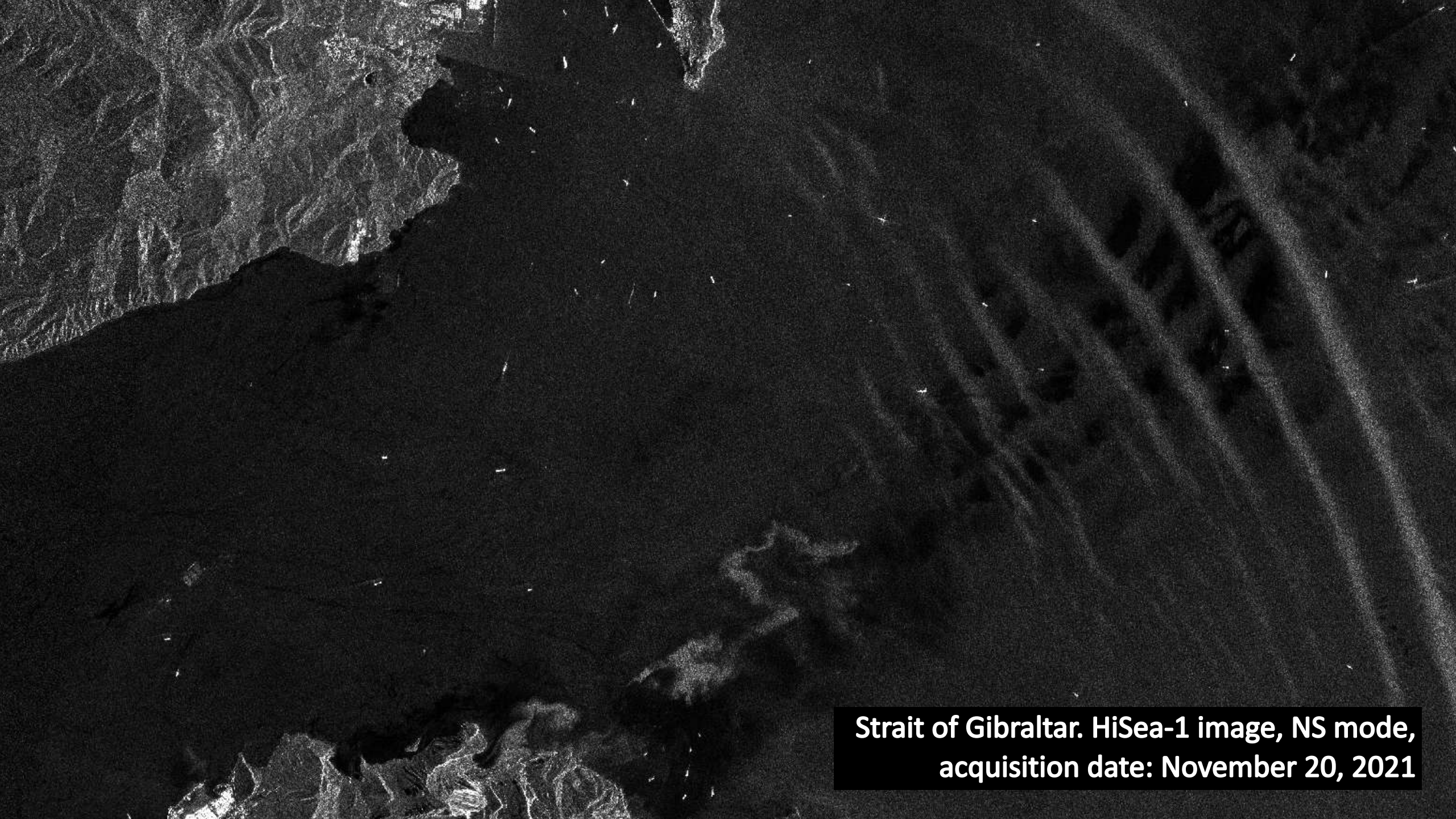
The station provides stable reception of signals in the entire upper hemisphere (from 10 deg. elevation) without a "dead zone" in the near-zenith area from a wide range of satellites with optical and radar equipment providing images with a spatial resolution of up to 1 m and better.

The control software of the station performs a fully automated cycle of the station operation without operator participation.

Silybum: image examples







Strait of Gibraltar. HiSea-1 image, NS mode, acquisition date: November 20, 2021

South Korea. Chaohu-1 image, SP mode, acquisition date: June 13, 2022

Planum

THE PLANAR STATION FOR RECEIVING SPACE INFORMATION FOR MOBILE PLATFORMS

The planar station for receiving space information for mobile platforms is designed to receive and process digital information transmitted from meteorological satellites such as the Meteor-M No. 2, NOAA, MetOp, FengYun-3 via L-band radio channels.

To receive radio signals from artificial Earth satellites (ISS), an antenna is used, which is a flat phased array. The station allows you to receive information from the satellite both in a stationary state and during the movement of a mobile platform (ships, railway platforms, cars, etc.). The hardware and software system of roll compensation and dynamic orientation to the cardinal points allows you not to use the traditional gyro platform in such cases.

The control software of the station performs a fully automated cycle of its operation without operator intervention.

Developed with grant support from the Innovation Promotion Foundation.

Testing the Planum station on the water. Expedition to Baikal in 2022 with students of the gymnasium of Moscow State University

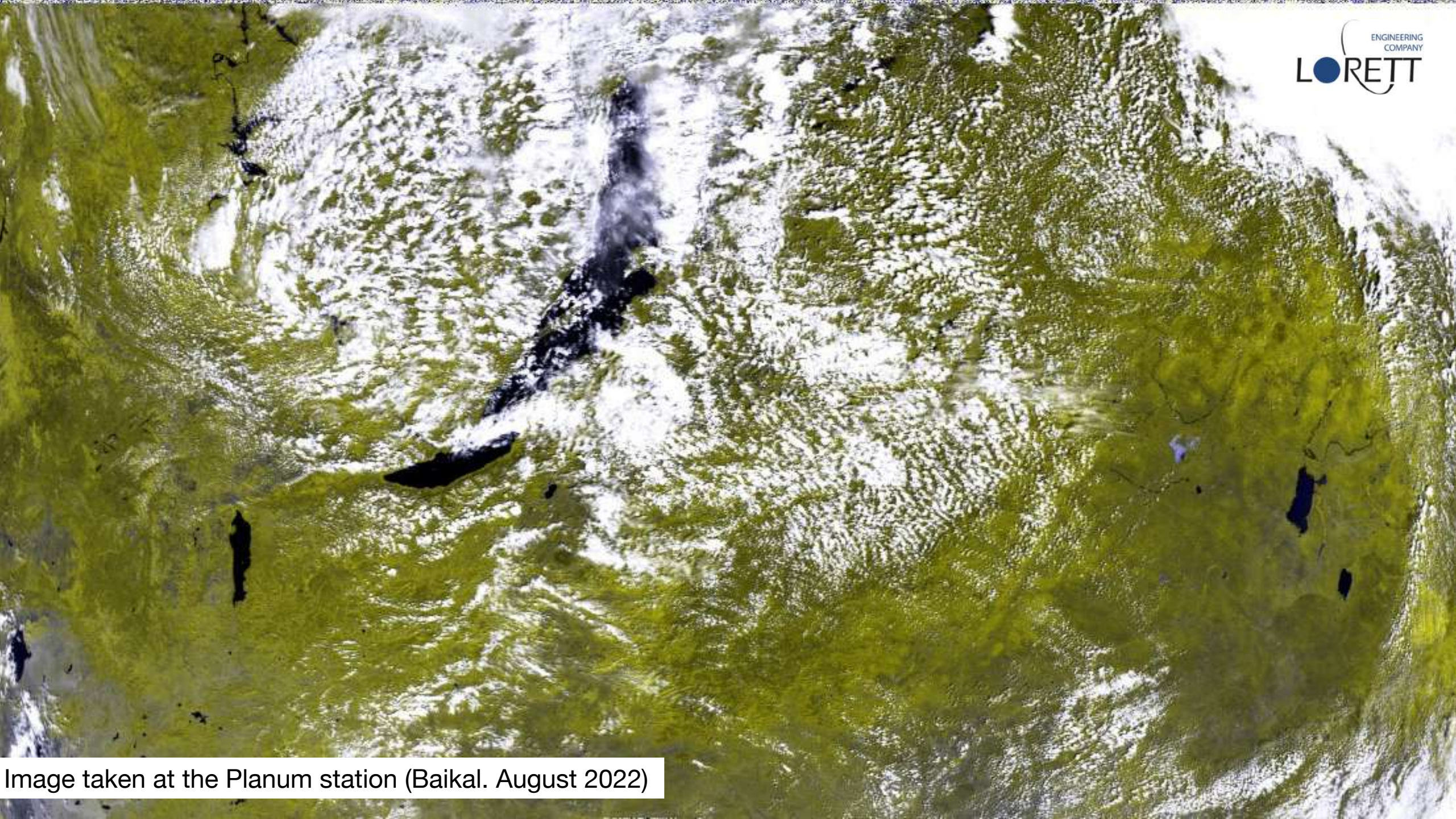


Image taken at the Planum station (Baikal. August 2022)

Planum

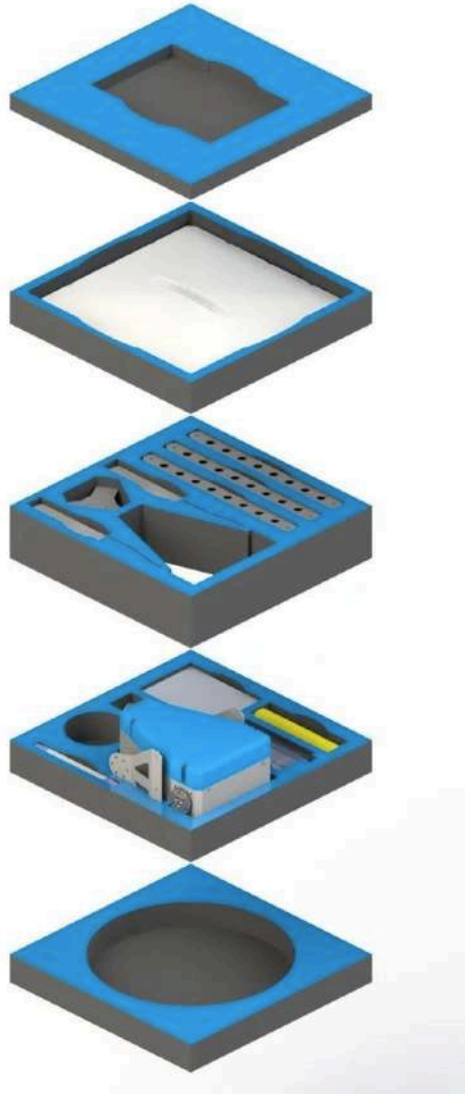
ENGINEERING CONSTRUCTOR

Designed for assembling a ground station for receiving and processing digital information transmitted from meteorological satellites of the Meteor-M No. 2, NOAA, MetOp series via L-band radio channels.

To receive radio signals from satellites, a flat phased array is used as an antenna.

Planum engineering constructor can operate for a day on battery power without connecting power cables.

Real-time data from meteorological satellites received by Planum in Moscow



Link2Space

ENGINEERING CONSTRUCTOR

Consists of components of an antenna system, an SDR receiver, a laptop, software for receiving and processing data.
Students assemble Link2Space and get a station (complex) for receiving satellite information, configure it and receive data from flying meteo satellites such as the Meteor-M No. 2, NOAA, MetOp, FengYun-3 via L-band radio channels in real time. Then the received images of the Earth from space are processed and analysed.

Goals achieved in the educational process:

- Creating a lively interest of students in scientific and technological activities;
- Attracting young people to the Russian space industry in terms of remote sensing of the Earth, which is one of the fundamental;
- Formation of children's interest in solving adult problems related to ecology and meteorology;
- Teaching children to work in a team, the ability to defend their interests and achieve their goals;
- Teaching children to work with new materials and equipment, work with electronics and learn the basics of programming.

Developed with grant support from the Innovation Promotion Foundation.

Examples of educational activities with Link2Space

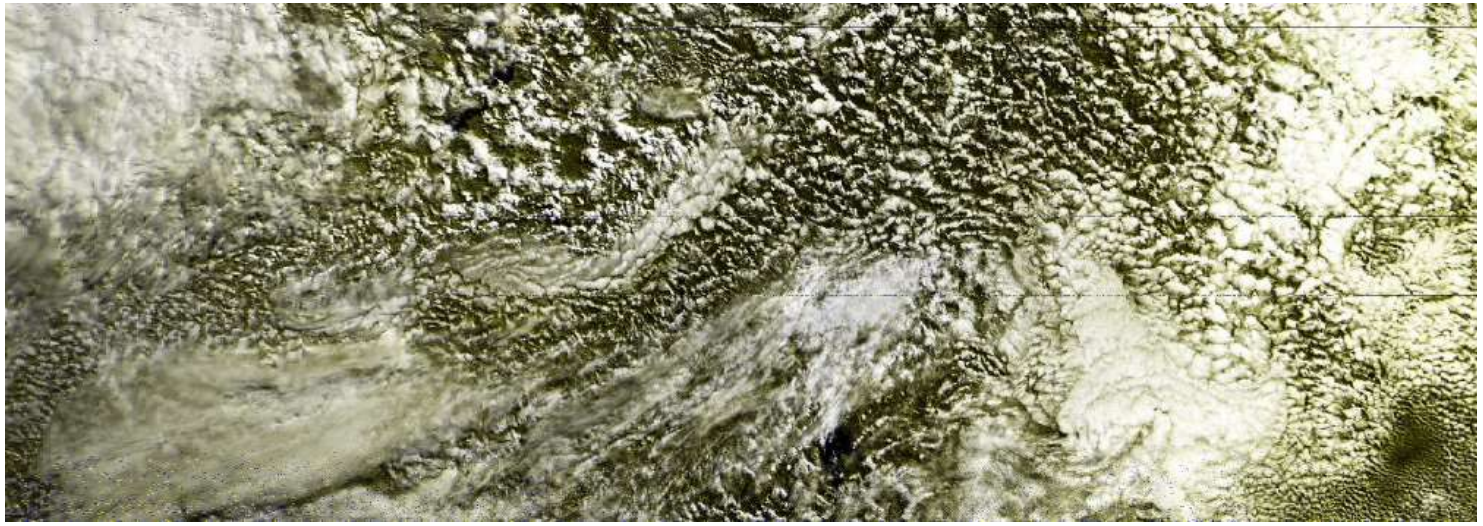
- «1 day with Link2Space» training
- Project based on Link2Space
- Link2Space education club
- Courses for teachers and tutors

MOPS

ENGINEERING CONSTRUCTOR

EDUCATIONAL ACTIVITIES WITH MOPS:

1. **Engineering and design training** (as a separate event or as part of an intensive course).
2. **Engineering project "Ground stations for receiving operational satellite data"** (5-6 days/36 hours).
3. **Engineering club (10+)** – a module as part of an additional course.



Satellite image, received by MOPS

Copter4Space

ENGINEERING CONSTRUCTOR

It consists of a COEX Clover 4 Code copter building kit, radio electronic units and all necessary components for installing an irradiator for receiving satellite images on a quadrocopter, a parabolic mirror with a marked airfield, a laptop, software for receiving and processing data.

Students independently assemble a drone, install an irradiator with the necessary radio engineering elements, assemble and adjust the airfield and reflector, configure it and receive space images of the Earth from flying meteo satellites such as Meteor-M No. 2, NOAA, MetOp, FengYun-3 on radio channels of the L-frequency range in real time with the possibility of their subsequent thematic processing and use in a wide range of scientific and practical tasks.

The building kit can be included in the infrastructure that provides project activities and programs of basic and additional education.

Copter4Space

ENGINEERING CONSTRUCTOR

LEX

COMPLEX-CONSTRUCTOR

Designed for assembling a turnstile antenna for receiving and processing data from meteosatellites Meteor-M No. 2, NOAA on VHF radio channels (137 MHz). It consists of the antenna itself and a tripod.

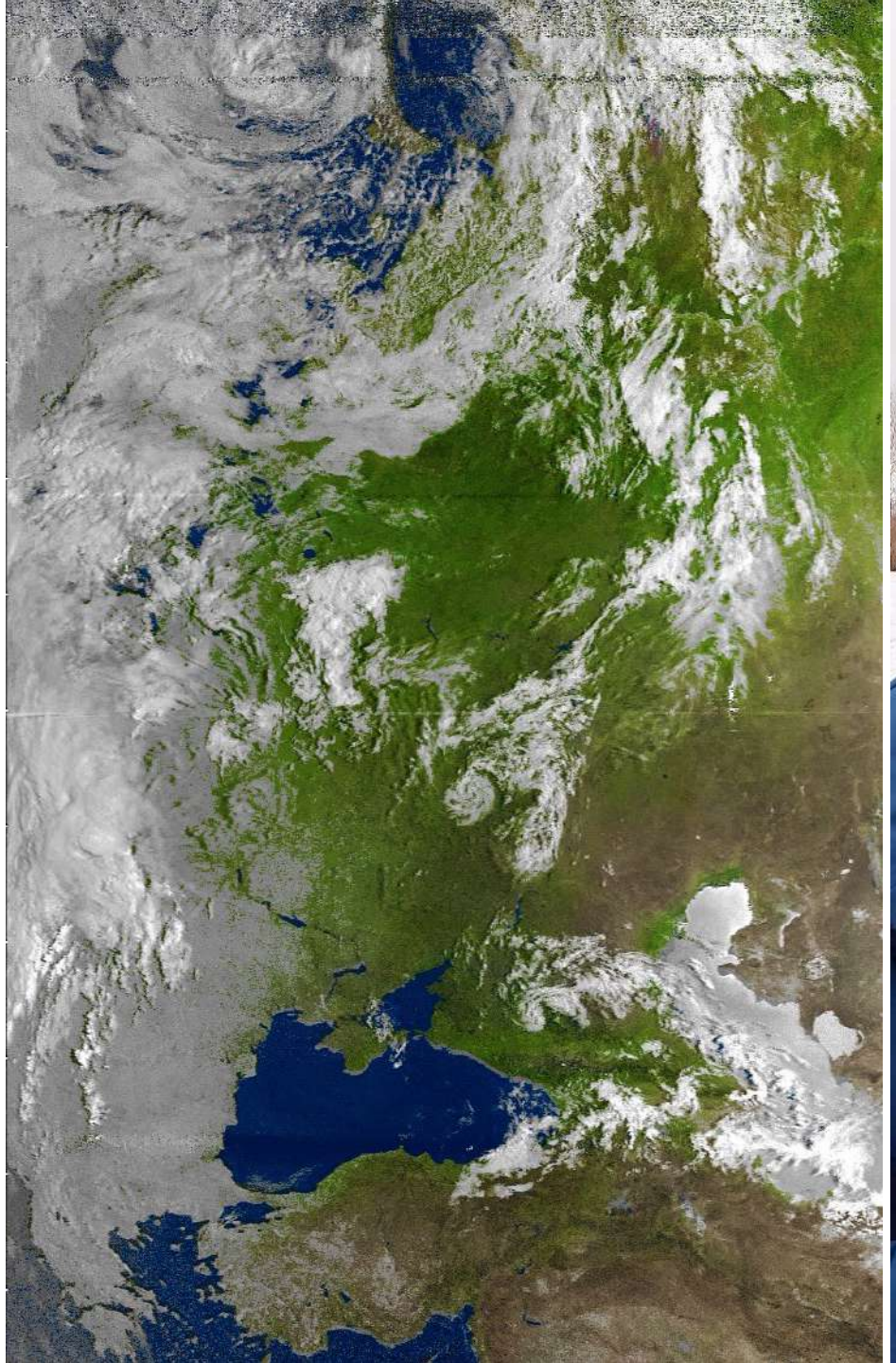
The goals achieved by using the kit in the educational process:

- creating a lively interest of students in scientific and technological activities;
- attracting young people to the Russian space industry in terms of remote sensing of the Earth, which is one of the fundamental;
- formation of children's interest in solving adult problems related to ecology and meteorology;
- teaching children to work in a team, the ability to defend their interests and achieve their goals;
- teaching children to work with new materials and equipment, work with electronics and learn the basics of programming.

Task: Assemble the turnstile antenna yourself, get real-time images from weather satellites, process images in order to view and analyze them.

The data collected by the assembled kit may be used:

- geography lessons to secure sections "Continents, oceans, peoples and countries," "Geography", "Regional geography";
- in science lessons while studying the "Vector and raster graphics", "Cataloging files", "software Application", "data Processing";
- in physics lessons to study the Optics section, as well as as additional extracurricular activities. Conducting classes is possible both in a group and in an individual mode.



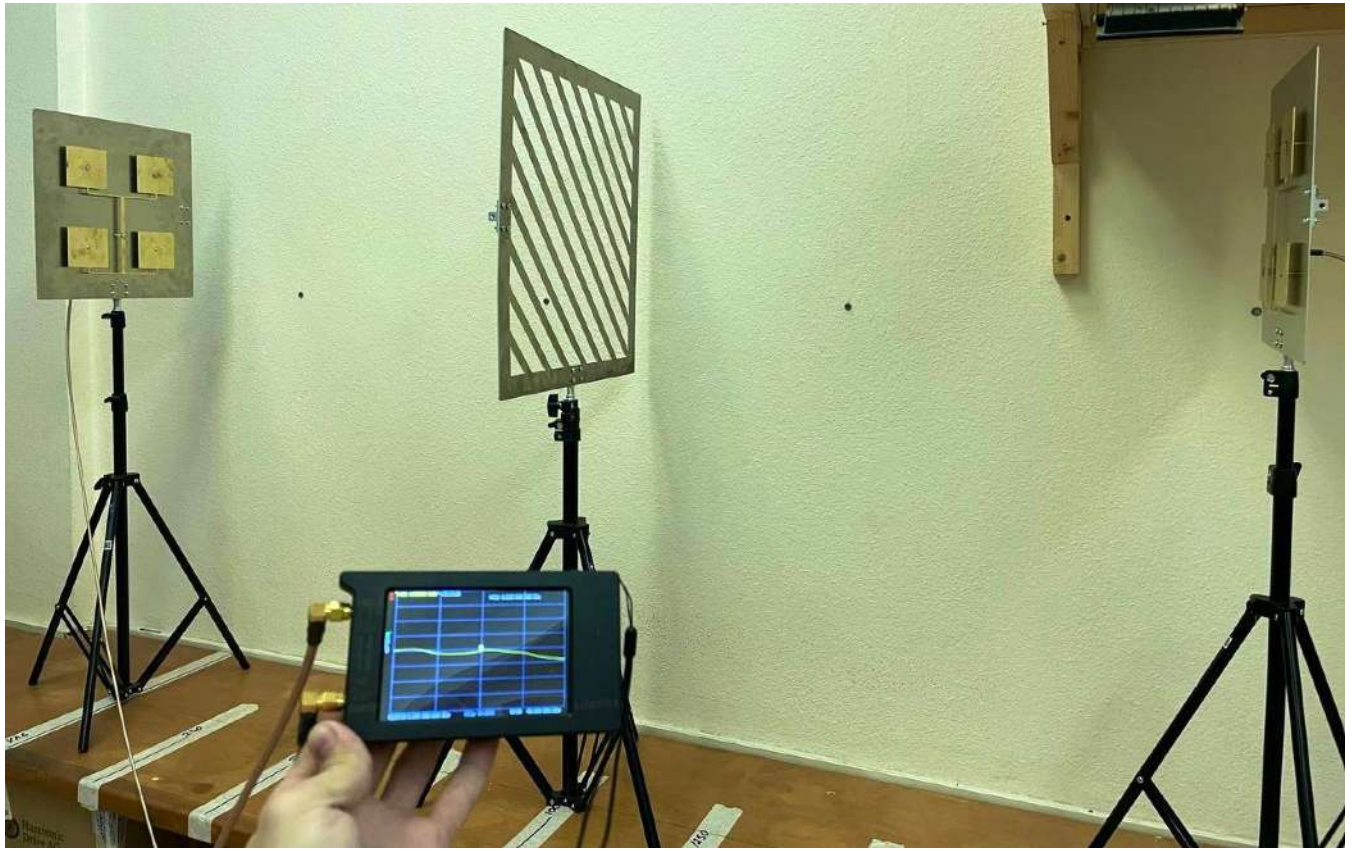
Measuring Stand

Measuring stand for testing sheet materials for radio transparency and radio transmission

The purpose of the stand is to measure the antenna pattern, study the polarization properties of the electromagnetic field, study the reflective and transmissive properties of sheet materials of various types. Designed to measure the characteristics of antenna systems in the frequency range 50 kHz - 6.3 GHz.

The stand represents a single technological chain, no additional adaptation is required to coordinate the devices. Supplied with a user manual in electronic form.

Measuring Stand



- Testing and data reception are carried out indoors to avoid interference.
- For this lesson you will need: a measuring stand; laptop, 3-4 pcs. prepared sheet materials (sheet materials are supplied complete with the stand).

«How to catch a satellite» game (6+)

The board game "How to Catch a Satellite" is aimed at popularising space technologies, technologies for receiving and processing images of the Earth from space, satellite meteorology and weather forecasting technologies using the LEX complex-constructor, and working with geographic information systems and spatial data.

Target audience: older preschoolers, primary and secondary school students.

The game includes:

- LEX complex-constructor
- «Images of the Earth from space» set
- 3 large IQ-puzzles
- 5 mini IQ-puzzles
- 3 SpaceMEMO
- Laptip (not included in delivery)

The game can be used:

- for geography and computer science lessons;
- during additional extracurricular activities, master classes and other events;
- for family leisure.

Space technologies in school education: application experience and prospects

Education

Our most important task is educational activities. We hope to educate a generation of people who understand the importance and benefits of space images and are able to change the future world around them. Our educational projects are addressed to schoolchildren, mentors, students, teachers, as well as anyone who is interested in the Earth observation from space. These are courses, lectures and seminars, master classes and trainings, competitions, thematic projects and clubs in children's camps, career guidance events.

We transform school geography into a modern "living" science with research and innovation components. We offer the subject of the future and technology for the conscious choice of a promising and in-demand profession!

The Interdisciplinary Laboratory "Earth from Space" at the joint of geography, informatics, physics, biology and other subjects will allow to involve schoolchildren in project activities and participation in domestic and international competitions, hackathons, olympiads, conferences and exhibitions.

Lectures, seminars, master-classes

SIMPLY ABOUT COMPLEX SUBJECTS FOR CHILDREN AND ADULTS: THE THEORETICAL FOUNDATIONS OF REMOTE SENSING OF THE EARTH AND THE DEVELOPMENT OF PRACTICAL SKILLS IN WORKING WITH IMAGES OF THE EARTH FROM SPACE AND GEOSPATIAL DATA

LESSON TOPICS (FOR EXAMPLE):

- «Images of the Earth from space: myths and reality»
- «From a balloon to video from space. A brief history of satellite imagery»
- «World of modern satellites»
- «Receiving and processing a signal from a weather satellite»
- «Space imagery and geospatial data in project activities of schoolchildren» (seminar for teachers and mentors)
- Art master class «Images of the Earth from space»
- «Space Fire Unit»
- «Space imagery for environmental monitoring and management decisions»
- «Land use: view from space»

Art master-class «Images of the Earth from Space»

Participants of the art master class «Images of the Earth from space» – 10 years old students of Educational Center #7 of Tula, Russia

Gallery of the results of the master class.

Educational Center #7 of Tula, Russia

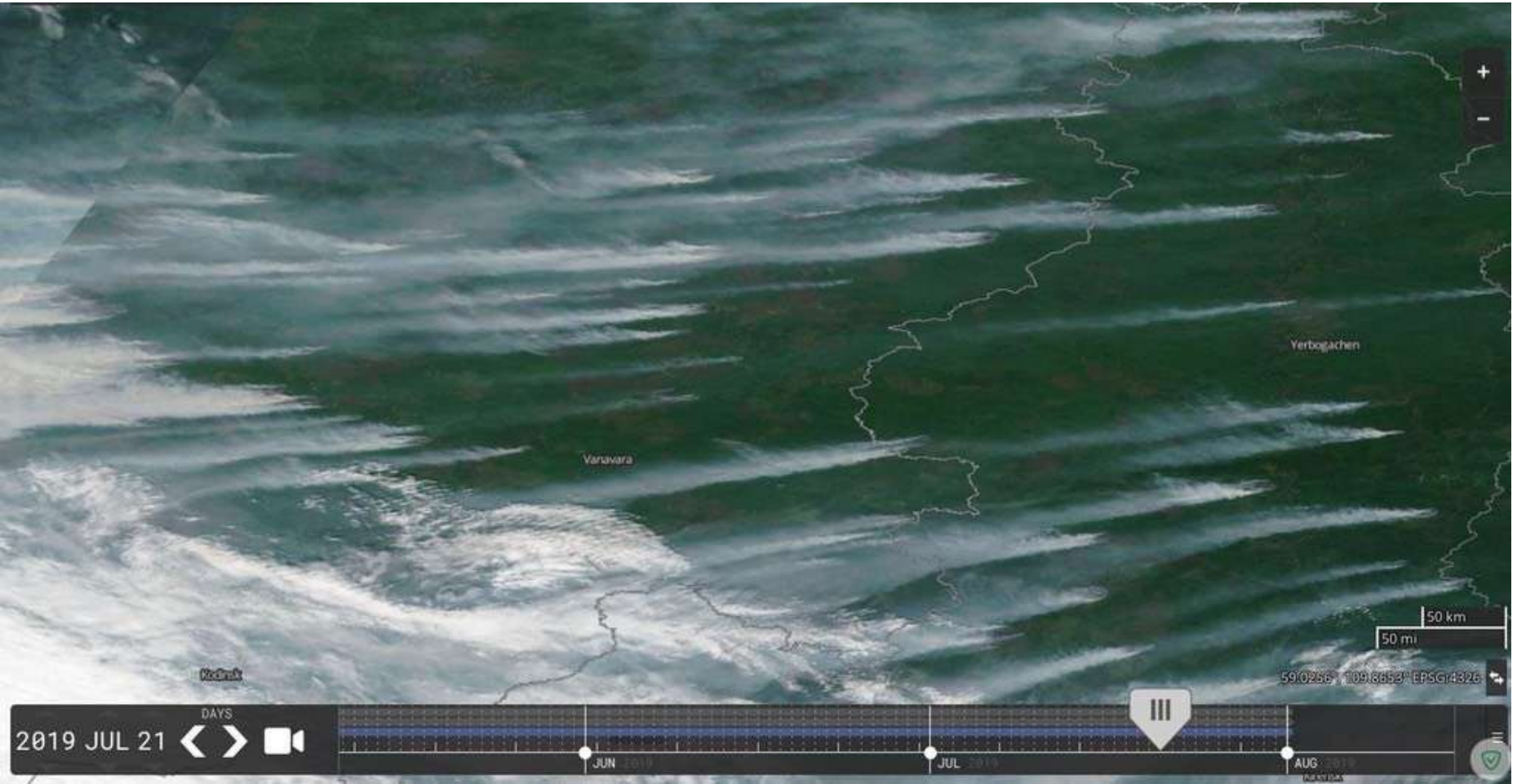
EXAMPLE:
FIELDS, RIVER AND SEA PORT

satellite image

artistic interpretation

«Space fire unit» master-class

Master class results: participants will create a map of fires and/or burned out forest areas for the area of interest, and compare it with neighboring territory, as well as with the situation a year ago in both areas.



Fire situation in the Krasnoyarsk Territory (Tura, Vanavara, Kodinsk), MODIS data. Acquisition date: July 21, 2019.

Source: worldview.nasa.gov

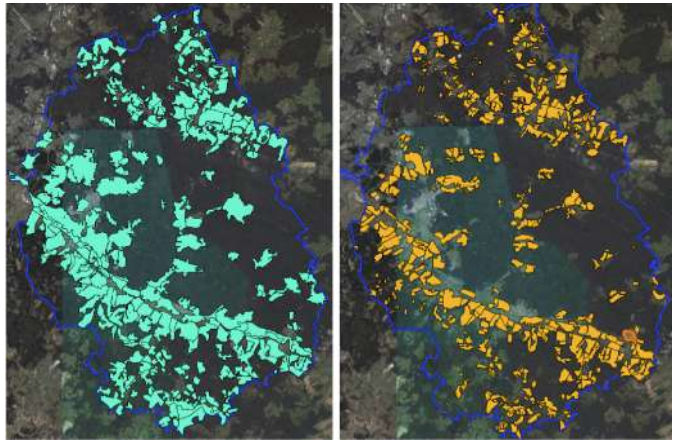
Express projects

PROMPT DEVELOPMENT OF THEORETICAL MATERIAL AND THE IMPLEMENTATION OF A GROUP ENGINEERING OR RESEARCH PROJECT

Engineering and research express projects based on technologies for receiving, processing and analysing Earth images from space and geospatial data are carried out by groups of 12-18 years old students accompanied by tutors during short-term educational events, intensives, camps etc. based on educational centres, schools, universities and other institutions.

On average, the implementation of an express project requires from several days to 2-3 weeks, depending on the chosen topic and a number of other conditions.

Examples: Land Use in Kaluga Region: View from Space (IRS-2019), Space Fire Department (IRS-2022)



Engineering training

MAKE SATELLITE DATA RECEIVING STATION UNDER THE GUIDANCE OF OUR ENGINEERS

As part of the training, the teams of participants assemble stations for receiving satellite information, configure them and receive data from passing weather satellites in real time at the station.

In the case of successful assembly and tuning of stations, teams should receive several images of the Earth from space with the possibility of their subsequent thematic processing. If the event lasts longer than one day, one part of the data reception can take place during working hours, another part – in the stand-alone operation of the stations at night.

The training is aimed at high school students and adults who are fond of technical creativity, in particular, programming, electronics and design, as well as astronomy and physics.

If several stations are planned to be assembled, then competitions between teams are possible on the quality of the received signal, which directly depends on the assembly and tuning. The quality of the received data and the success of the reception are evaluated by an expert jury. The competition regulations and the protocol for evaluating the received images have been developed.

Education festivals

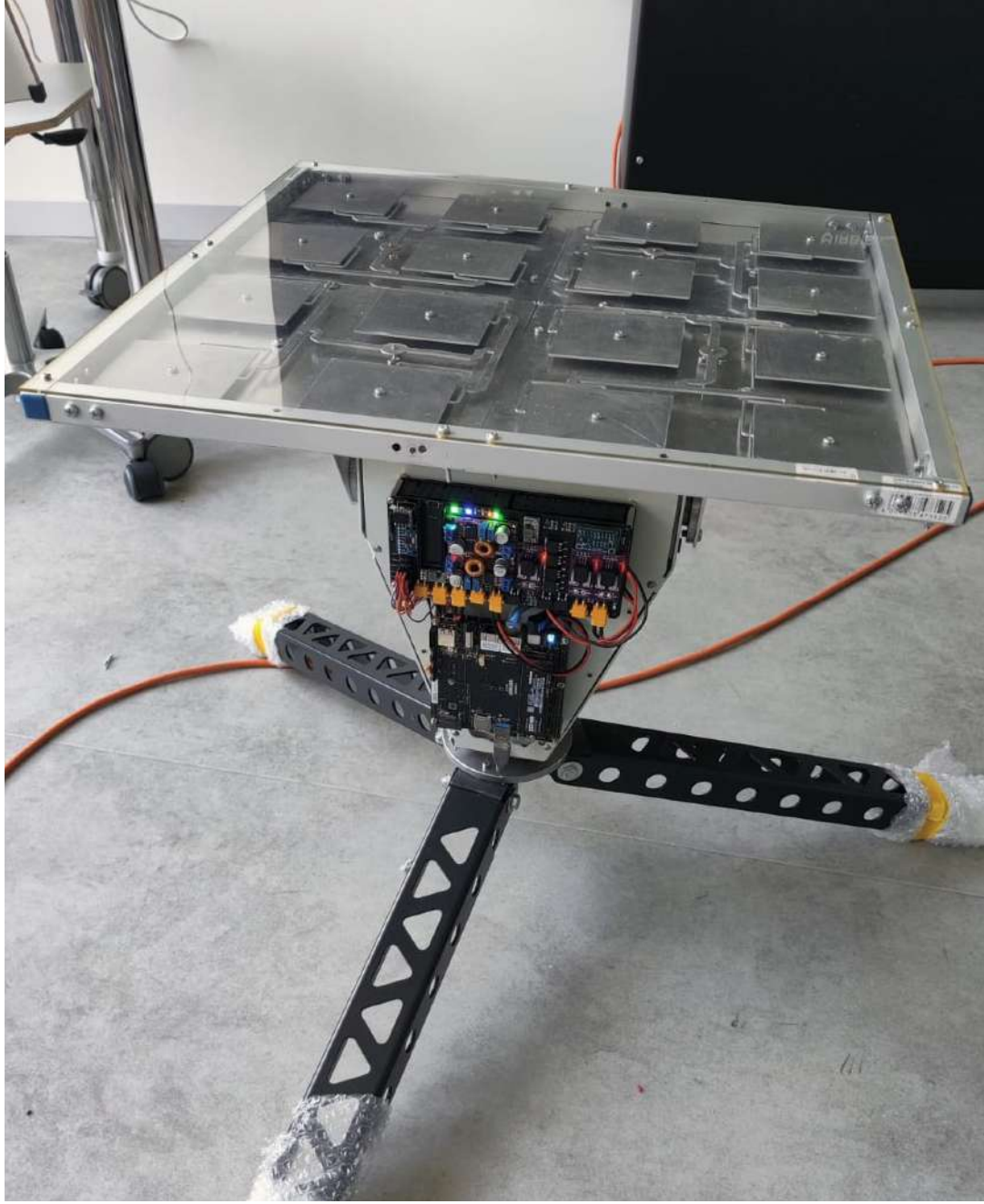
REGIONAL SEMINARS, BUSINESS PROGRAMS BASED ON YOUR ORGANISATION

Vacation trainings for children

LEARNING NEW SKILLS AND KNOWLEDGE WHILE RELAXING

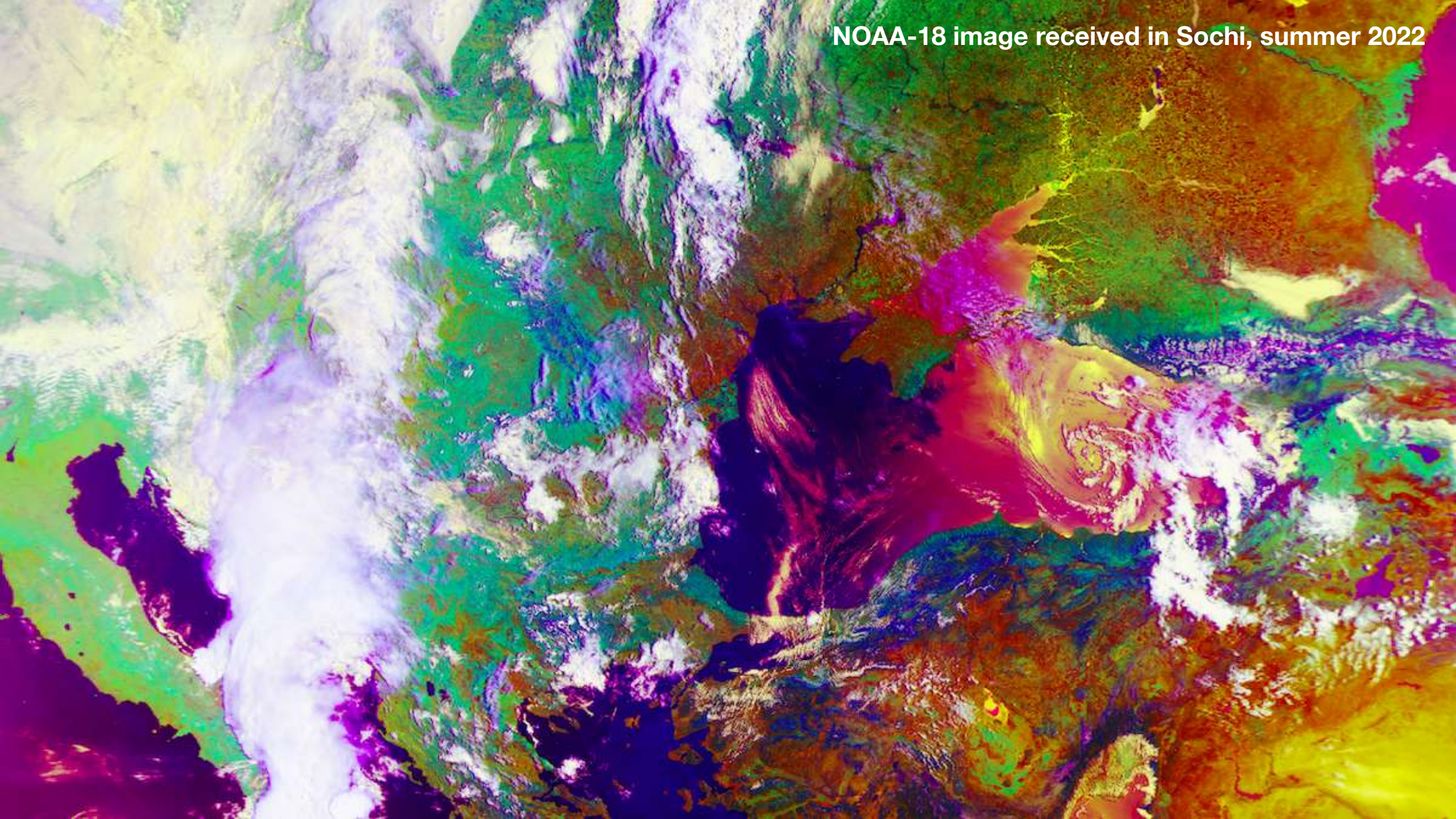
Engeneering and research projects in children's camps under the guidance of our experts are an opportunity to get acquainted with the world of space technology, broaden your horizons, pump hard&soft skills and implement impressive projects based on images of the Earth from space.

Image from NOAA-18 meteorological satellite received by school students using their own experimental ground receiving station. Kaluga, April 2022



Summer 2022, Sochi, Planum training

Summer 2022, Sochi, final conference


NOAA-18 image received in Sochi, summer 2022

«On duty for planet» program: engineering contest

OPERATIONAL SATELLITE MONITORING

NEW CHALLENGE EVERY YEAR!

2019-2020: design and construction of a receiving station based on an engineering designer, receiving and processing data from meteorological satellites

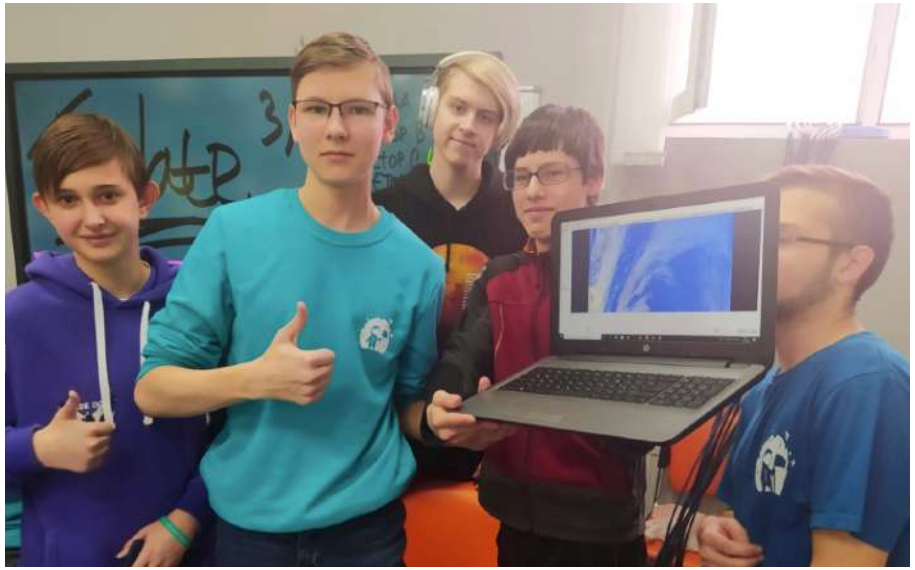
2020-2021: receiving data from the satellite by moving the drone over the reflector

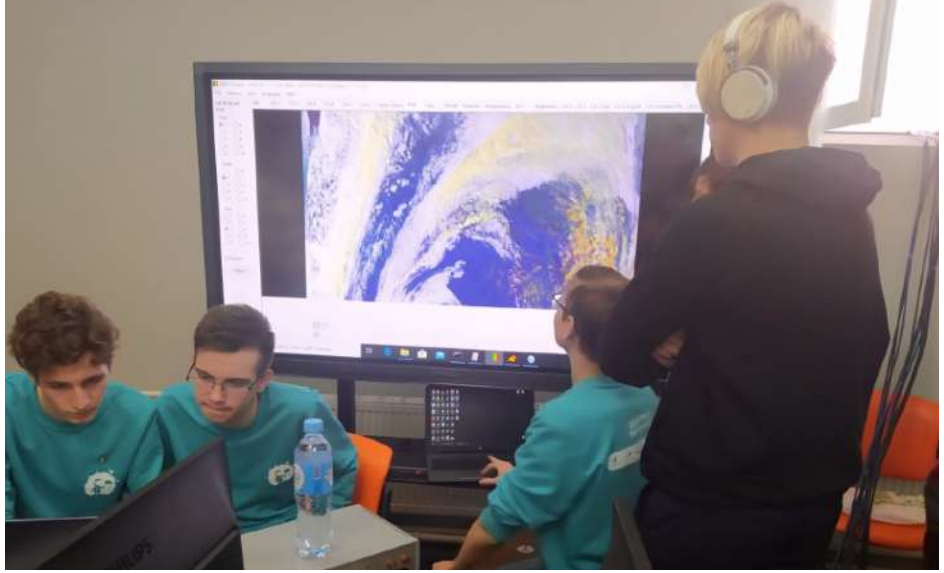
2021-2022: creation of a data receiving station for mobile platforms

2022-2023: creation of a receiving station using a specialized UAV

Testing sessions. Sirius 2020 Space Program, Korolev, Russia

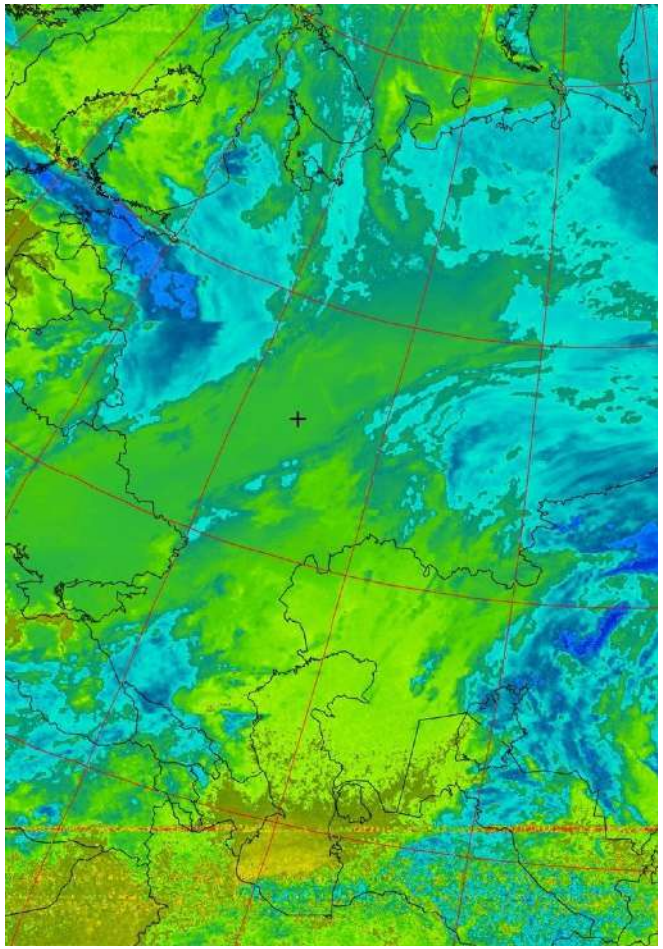
Receiving images from meteorological satellites in real time mode





Space technology at school

All school's classes can participate in the program



Lesson "The world around us" in primary School No. 13 in Arzamas, Russia.
Children assembled LEX construction-complex and received a signal from the NOAA-18 satellite in real time.

Project activities and clubs

"Interdisciplinary Space Cluster" club for grades 4-8 at the "Phystech Lyceum» (2019-2022)

Educational outcomes

WORKING WITH LORETT TECHNOLOGIES, STUDENTS GET NEW KNOWLEDGE AND SKILLS

- mastering full-cycle skills from assembling and tuning a receiving antenna to obtaining a satellite image in real time and creating your own project in the field of using remote sensing data;
- obtaining new knowledge and skills in processing and analyzing images of the Earth from space based on geographic information systems (GIS) and WEB technologies for weather forecasting and natural hazards, emergencies, ecology, agriculture and forestry, territory management, etc.
- professional identity.

- **Engineering**
- **Construction**
- **3D modeling**
- **Electronics**
- **Programming**
- **Thematic analysis**
- **Management**
- **Promotion**
- **Soft skills**

IMPLEMENTATION AT DIFFERENT LEVELS OF THE EDUCATIONAL SYSTEM

INTEGRATION OF VARIOUS DISCIPLINES AND DIRECTIONS

INNOVATIVE APPROACH | MOTIVATION TO LEARN | SOCIAL SIGNIFICANCE

Creative weekend

NEW IDEAS FOR THE WHOLE FAMILY, FRIENDS OR WORK TEAM

Edutainment ("learning as entertainment") is a modern educational and entertaining format for participants of any age and occupation, which allows you to spend free time in a pleasant company with benefit and pleasure, gain knowledge and develop skills in new areas.

Educational events on Edutainment technology are held in a relaxed atmosphere in a park, museum, office, cafe, etc. You can take part in them with the whole family, a company of friends or a team.

Looking for fresh ideas for corporate parties? Competitions in assembly of stations for satellite data reception, real-time acquisition of the Earth images from space and a satellite imagery quiz will be a fascinating addition or alternative to a classic evening in a restaurant or country club.

Consulting

CONSULTATIONS OF OUR EXPERTS ON THE APPLICATION OF TECHNOLOGIES FOR THE RECEPTION, PROCESSING AND ANALYSIS OF IMAGES OF THE EARTH FROM SPACE

The founders and employees of «LoReTT» engineering company have **30 + years of experience** in the industry of creating technologies for receiving, processing and using Earth images from space, they are experts in the field of Earth observation systems and their applications and are ready to provide information and consulting support to your projects on a wide range of issues:

- features of the market of technologies and remote sensing data;
- spheres of application of technologies and remote sensing data;
- industry development prospects;
- etc.

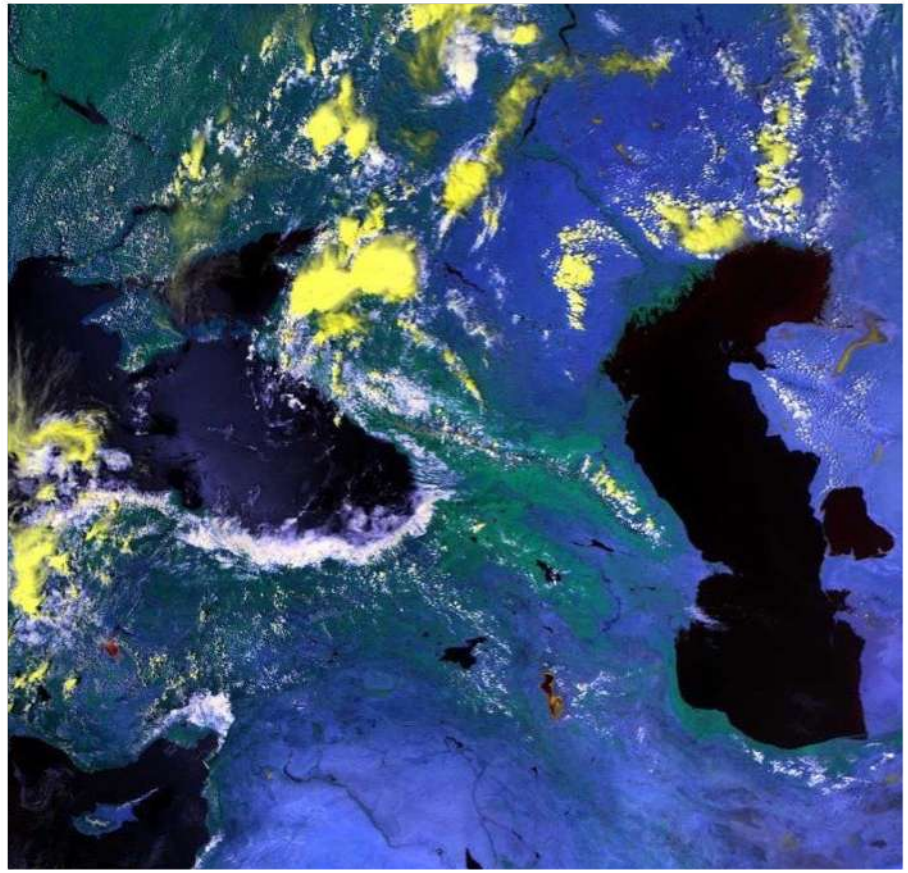
MODIS Real Time

PROVIDING METEOROLOGICAL DATA ON CLOUDINESS THROUGH THE MODIS / TERRA AND AQUA DATA SERVICE IN REAL TIME

"LoReTT" LLC provides users with initial data of space imagery and information products, obtained from MODIS radiometer data (Terra and Aqua spacecrafts), using standard algorithms for coordinated areas of interest:

- cloud mask (MOD35);
- data on the temperature of the upper edge of the cloud cover (MOD06CT).

"LoReT" LLC provides access to online data in 24/7 mode by an agreed login and password using the FTP protocol. Information is provided to users in HDF4 file format. The contents of the fields, their encoding and formatting within the HDF are described in the NASA documentation for respective products. "LoReTT" LLC provides users with a description of the format of the products. Approbation of the method and verification of the results were carried out jointly with the Institute of Radar Meteorology **(IRAM)**, St. Petersburg, Russia.



Educational materials and souvenirs

- Methodological recommendations for conducting classes
- Space IQ-puzzles
- MEMO – images of the Earth from space
- handout kits for quizzes on the topic “Images of the Earth from space”
- and much more!

Thank you for attention! We invite you to cooperate!

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