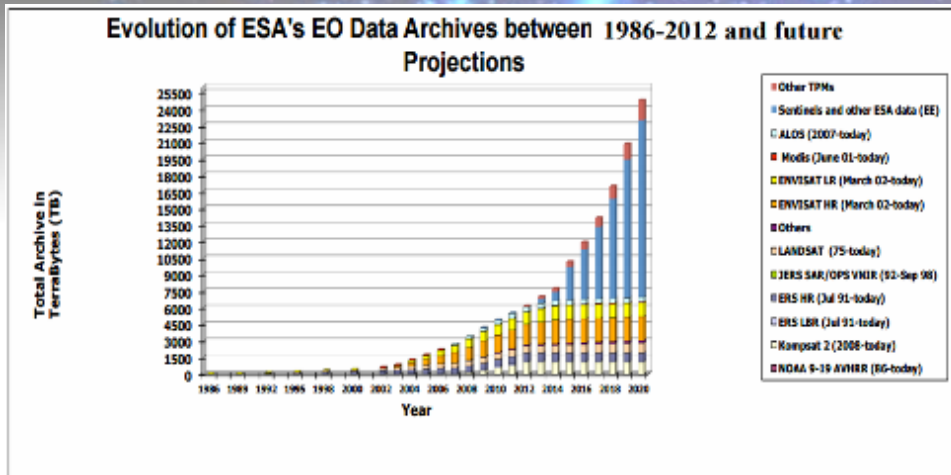


***System of Earth's Remote Monitoring
System in IKI and International
Collaboration.***

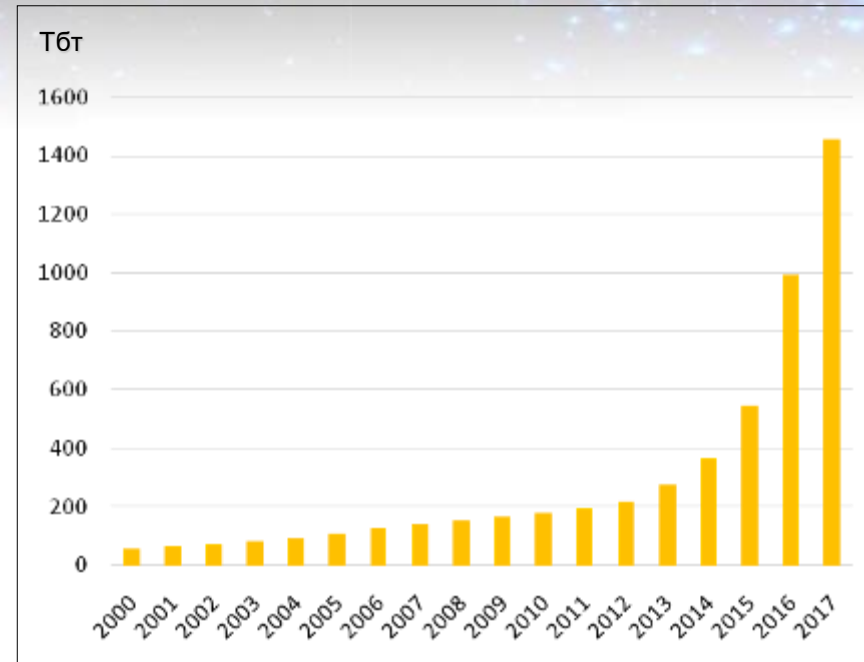
***Archiving, Processing and Analysis of
Satellite Data***

Lupyan E.A., Sadovski A.M.
Space Research Institute (IKI)

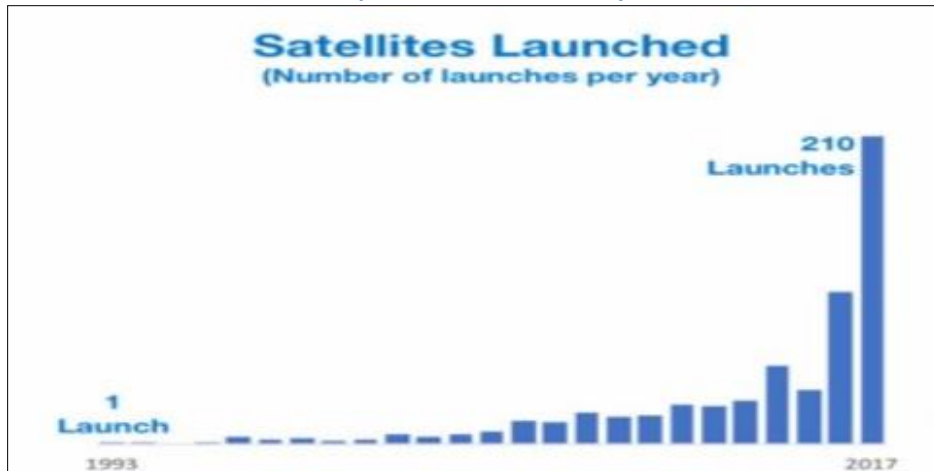
In recent years, there are the virtual explosive growth in the number of remote sensing satellites and the amount of receiving data



Archive volumes of ESA mission of Earth remote sensing 1986-2020
(Mirko Albani, 2012)



Volumes of online data archives in IKI
2000-2017



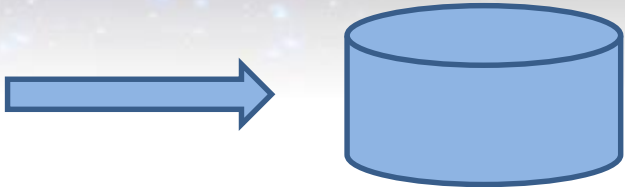
Number of remote sensing satellites 1993—2017
(Union for Concerned Scientists database, 2018)

Explosive growth of possibilities of Earth's remote sensing systems and volumes of received data requires fundamentally changes in the working schemes in scientific projects

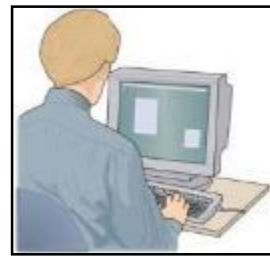
“Traditional” scheme of remote sensing system data analyses



Ordering and downloading remote sensing data from various sources



Maintaining a local archive of data on user computers

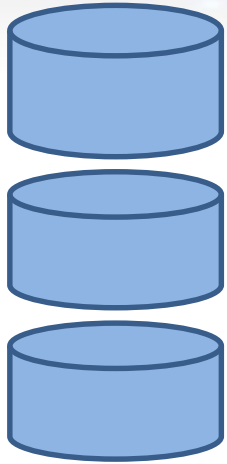


Work in desktop GIS:
QGIS, ArcGIS, ENVI, ERDAS ...

- Disadvantages:**
- Necessity of deploying costly data storage and processing infrastructure
 - Costs of special software development
 - Necessity of complex GIS software packages

“Contemporary” scheme of remote sensing system data analyses

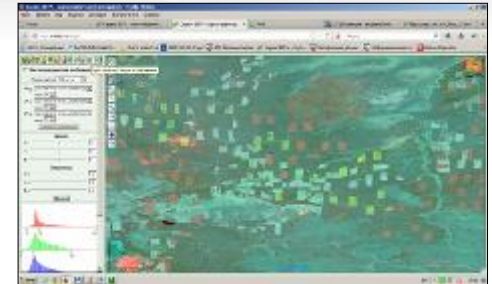
Distributed archives and computing resources of different centers



Data and resource services for processing and analysis



Browser



Advantages:

- Collective use of centralized resources for data storage and processing
- Using ready-made tools for data processing and analysis

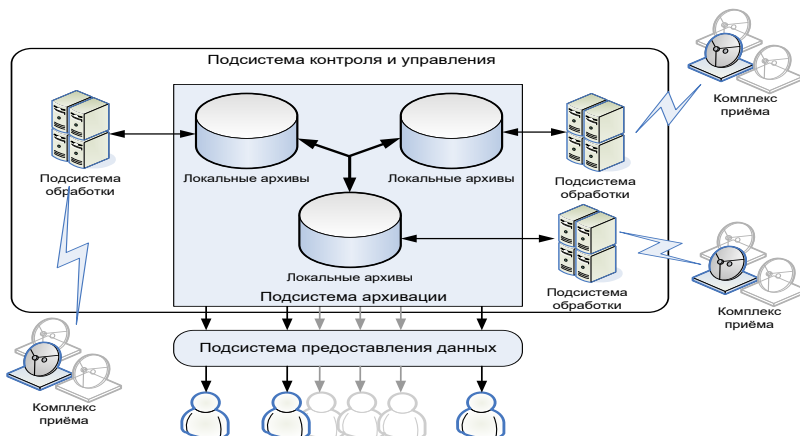
Main Tasks of IKI Earth's monitoring system

- *Automated maintenance of ultra-large distributed archives of satellite data and results of their processing*
- *Automated data streaming for various information products required for scientific research*
- *Provision of tools for satellite data processing and analysis using resources of IKI*
- *Provision of software interfaces to various remote monitoring information systems*

Technical Characteristics



- Total volume of online data archives is **over 3 Pb**
- Enables acquisition and assimilation of about **3 Tb per day**
- Total available capacity of online storage servers is about **4 Pb**
- Servers that provide distributed access to data - about **20**
- Stations and data processing servers - **about 100**



Information given on 10.12.2019

The main data sources

NOAA, Terra, Aqua, NPP, JPSS1

Метеор-М (МСУ-МР)

Канопус-В ИК

Meteosat,

Himawari-8

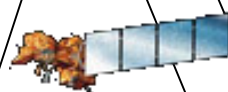
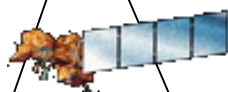
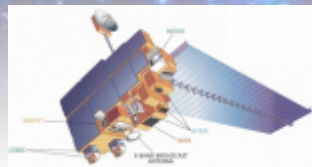
Электро-Л

Proba-V

Sentinel-3

Sentinel-5

100 м - 2 км



Landsat 4,5,7,8

Sentinel-1A/B

Sentinel-2A/B

Метеор-М (КМСС)

Ресурс-П (КШМСА)

Канопус-В (6 КА)

EOS-1 (Hyperion)

10-50 м

Канопус-В (6 КА)

Ресурс-П

БКА

МКС

1-5 м

20 - 60 км

80 - 180 км

2000 - 3000 км

Mainly focused on using **Russian and publicly available foreign data**

The system receives information from **Russian and foreign satellite data centers** for collection, processing and archiving centers.

Supports data from **more than 40 satellite systems**

Enables operation with data of **more than 30 types of observation devices**

The depth of archives reaches **35 years**

Information given on 10.12.2019

Green – Russian satellites systems

The Main Data Sources

Foreign

USGS (USA)

LANDSAT 4,5,7,8
EO-1
ORBVIEV-3
AQUA
TERRA
Suomi NPP
JPSS1(NOAA20)

LANCE (USA)

AQUA
TERRA

ESA (Europe)

LANDSAT 8 , EO-1
SENTINEL-1A,1B
SENTINEL-2A,2B
SENTINEL-3A
SENTINEL-5

VITO (Belgium)

PROBA_V

NCAR (USA)

Meteodata NCEP

Rosgidromet (SRC "Planeta")

ЕЦ НИЦ «Планета» (Moscow)

СЦ НИЦ «Планета» (Novosibirsk)

ДЦ НИЦ «Планета» (Khabarovsk)



Russian satellites:

Ресурс-П №1
Ресурс-П №2
Ресурс-П №3
Метеор-М №1
Метеор-М №2
Канопус-В
Канопус-В-ИК
Канопус-В №3
Канопус-В №4
Канопус-В №5
Канопус-В №6
Электро-Л №1
Электро-Л №2

Foreign satellites:

HIMAWARI-8
AQUA
TERRA
NOAA 15,16,18,19
Suomi NPP
JPSS1 (NOAA 20)
МЕТОР-В
GOES-E
GOES-W
MTSAT 2
METEOSAT 7
METEOSAT 8
METEOSAT 10
METEOSAT 11

Research Center for Earth Operative Monitoring (Roscosmos)

Ресурс-П №1
Ресурс-П №2
Ресурс-П №3
Метеор-М №1
Метеор-М №2
Канопус-В
Канопус-В-ИК
Канопус-В №3
Канопус-В №4
Канопус-В №5
Канопус-В №6

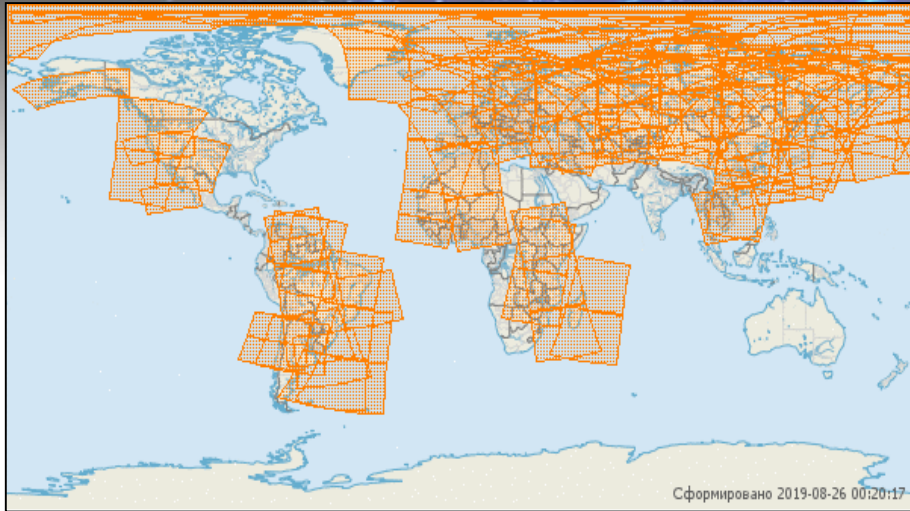
IKI (Moscow)



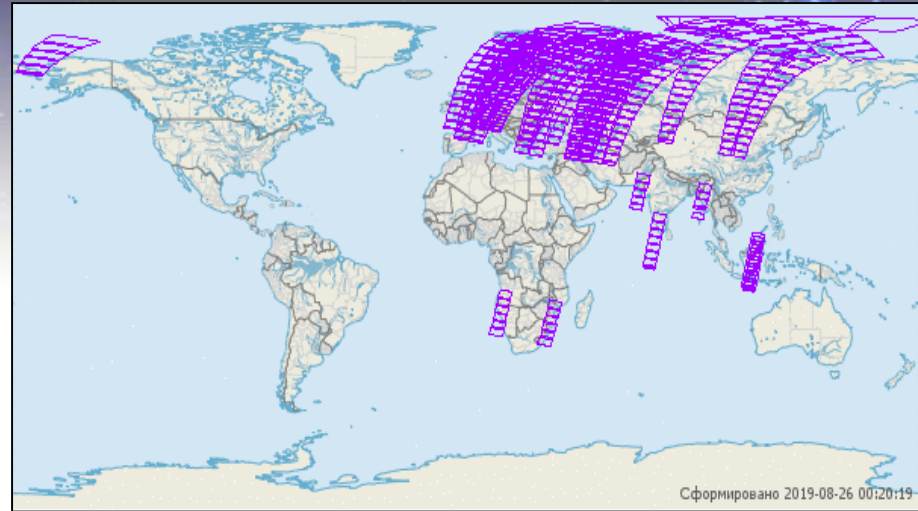
NOAA 18
NOAA 19

Users
data

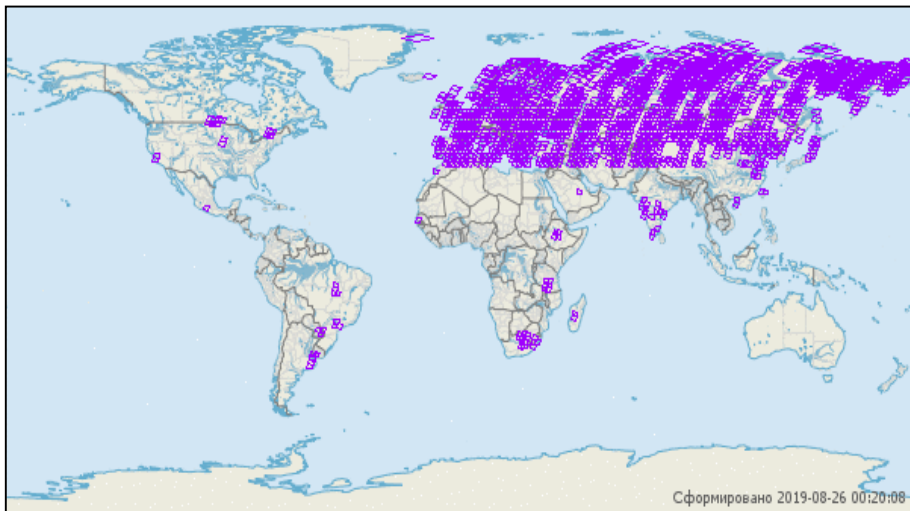
Examples of current data coverage for level L1B



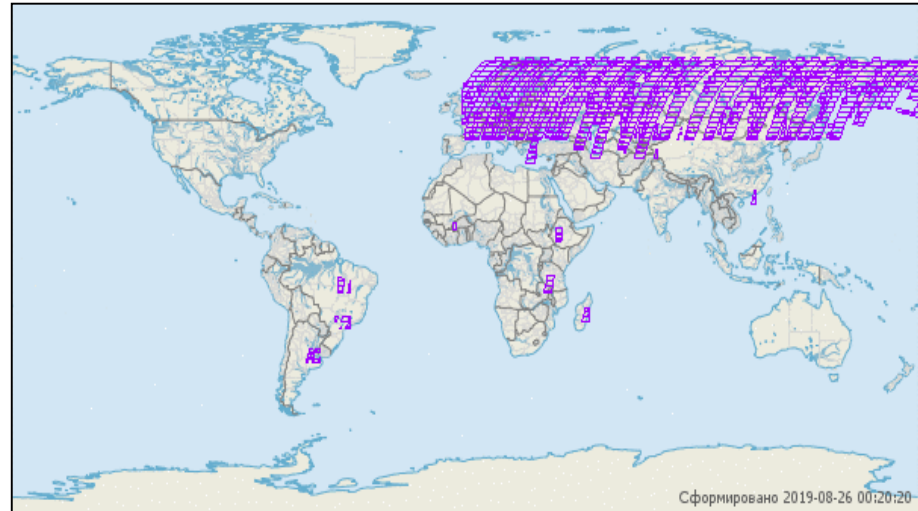
Modis, coverage on 26.08.2019



KMCC, coverage on 24-26.08.2019

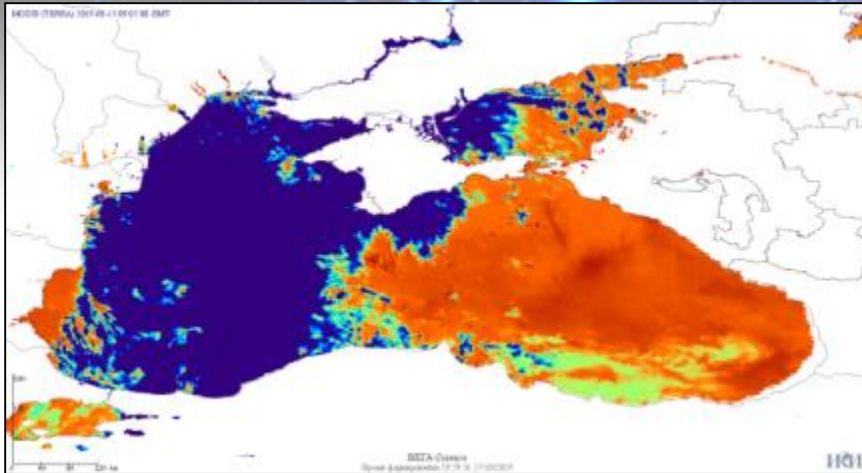


Landsat, coverage on 21-26.08.2019

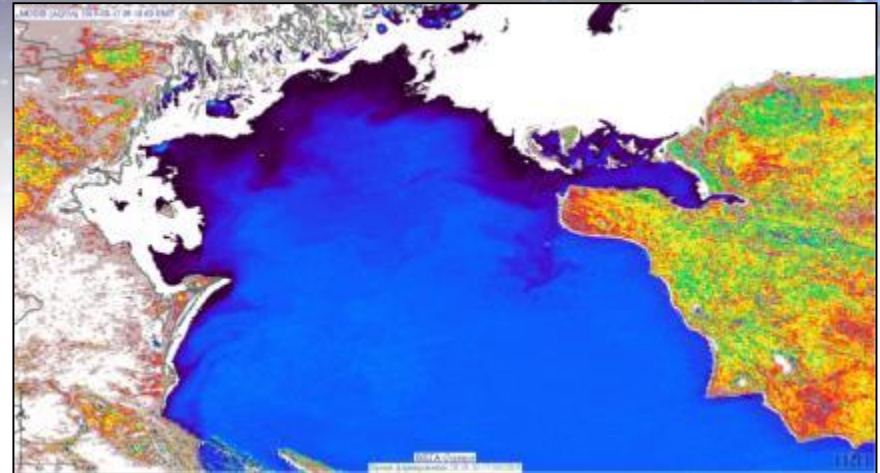


Sentinel-2, coverage on 21-26.08.2019

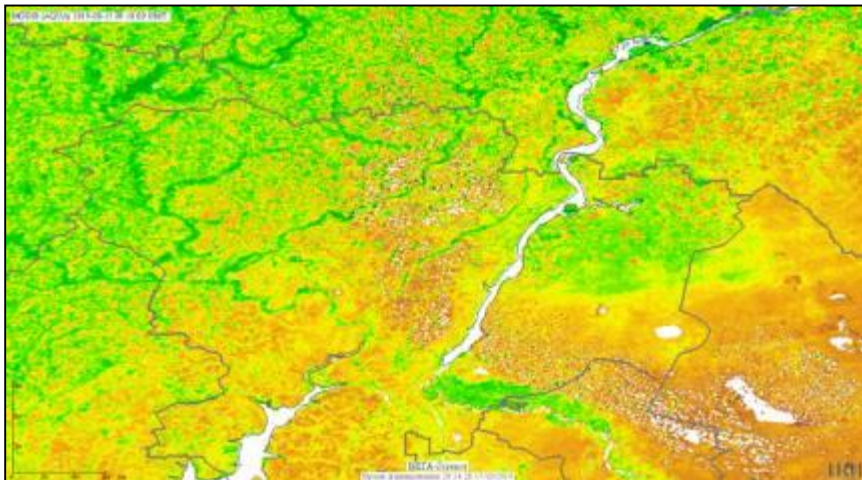
Examples of Level 2 products (session fields of different physical characteristics and indices)



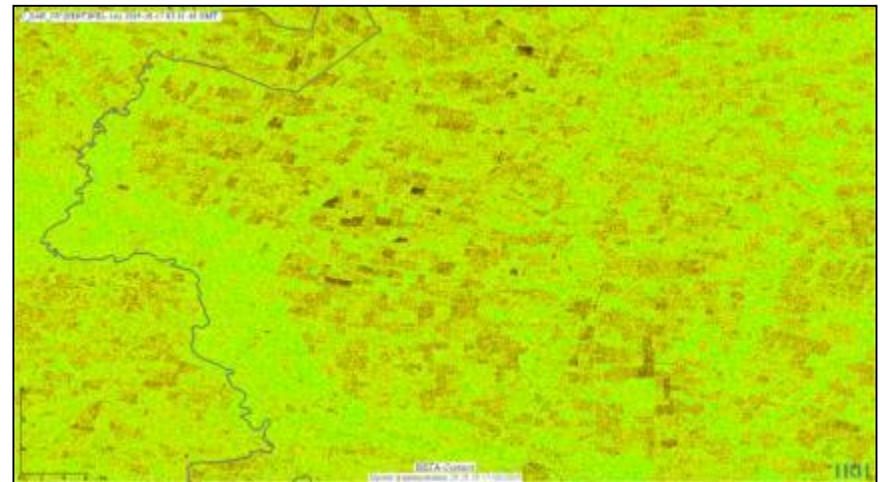
Temperature of sea surface



Index FAI



Vegetation index NDVI

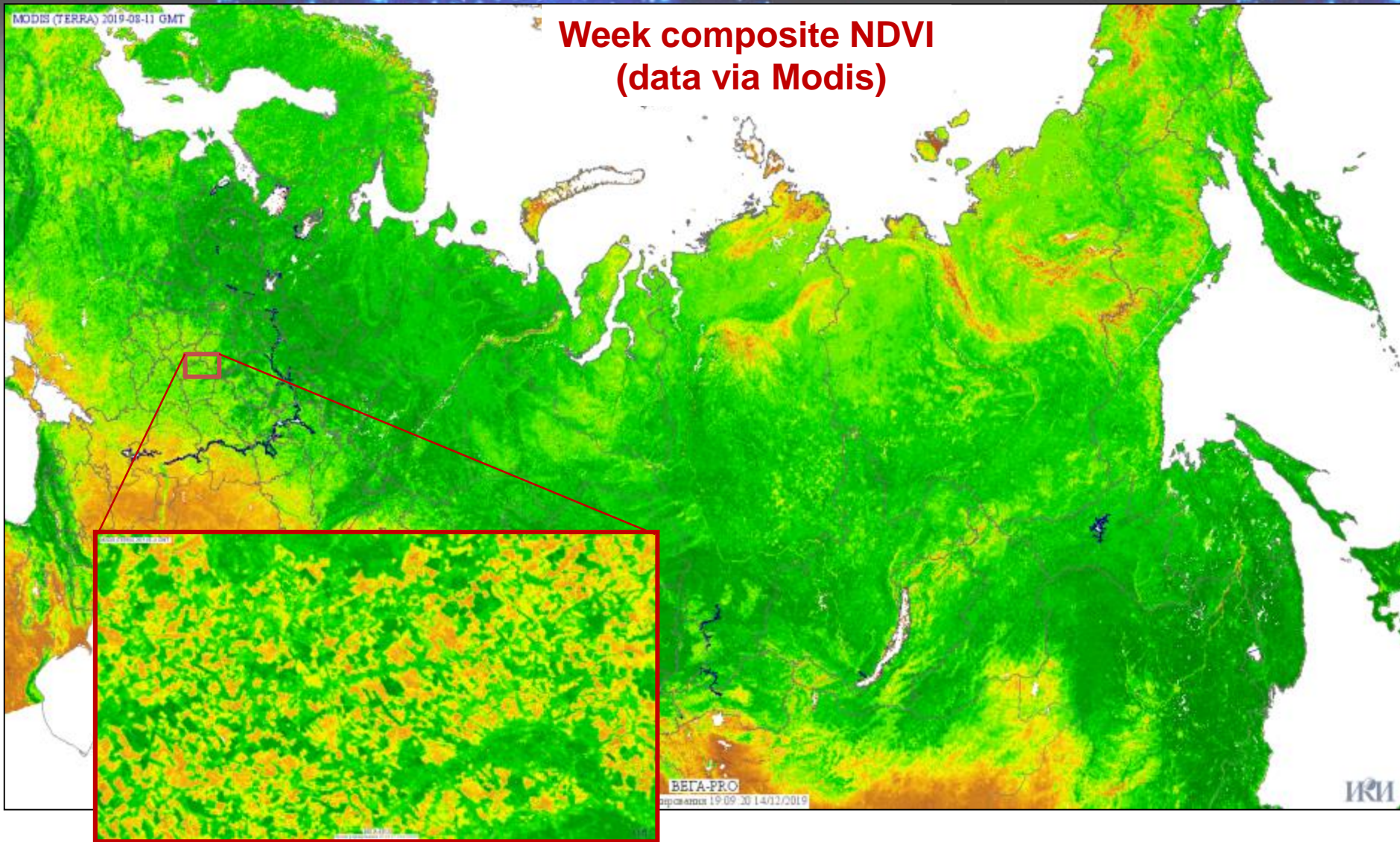


Radar vegetation index NRVI

The overwhelming number of Level 2 products is generated dynamically, online

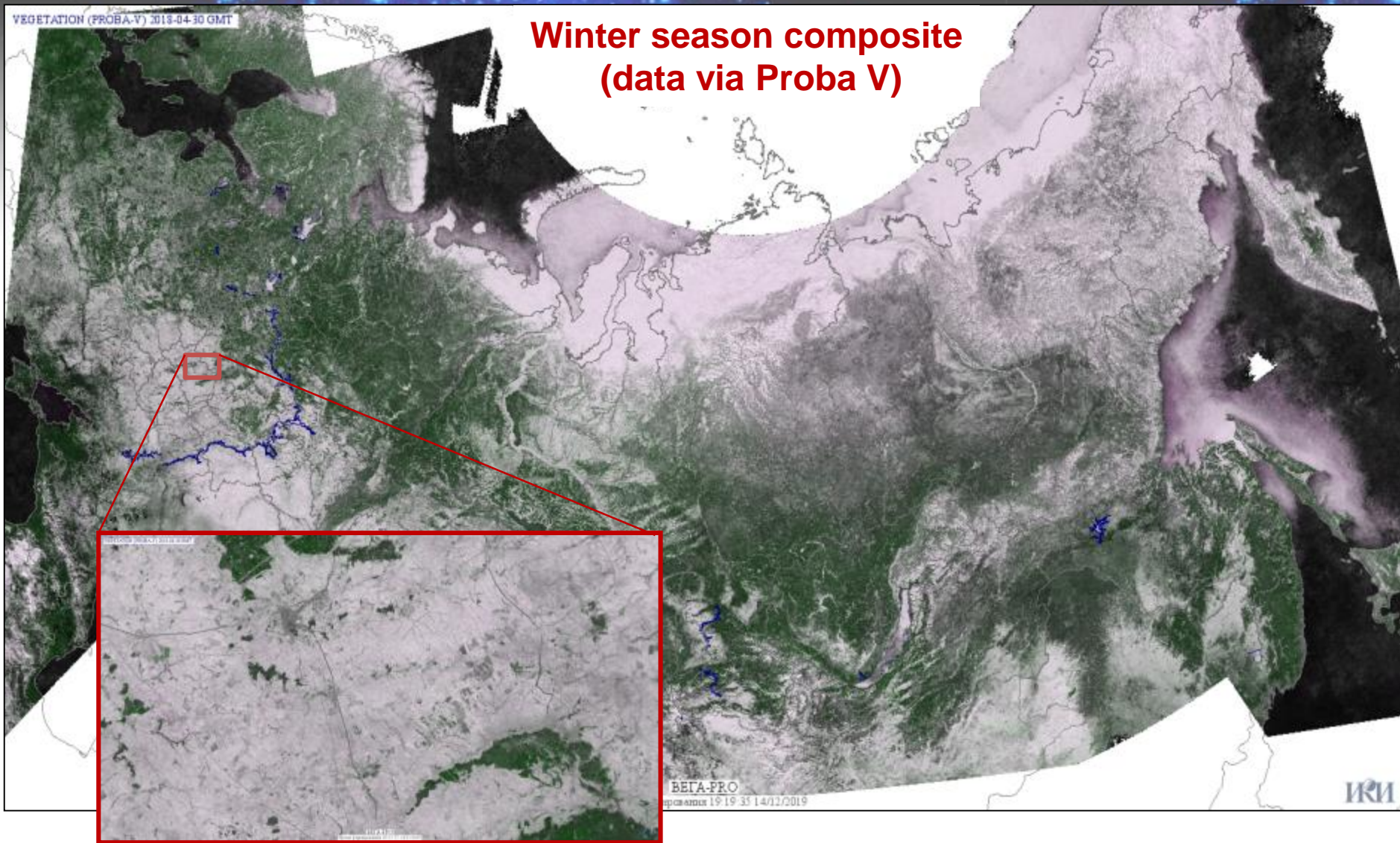
***Level 3 products - cloud-free time
composites***

Example of cloud-free composite image with Aqua/Terra (MODIS) (250 m)



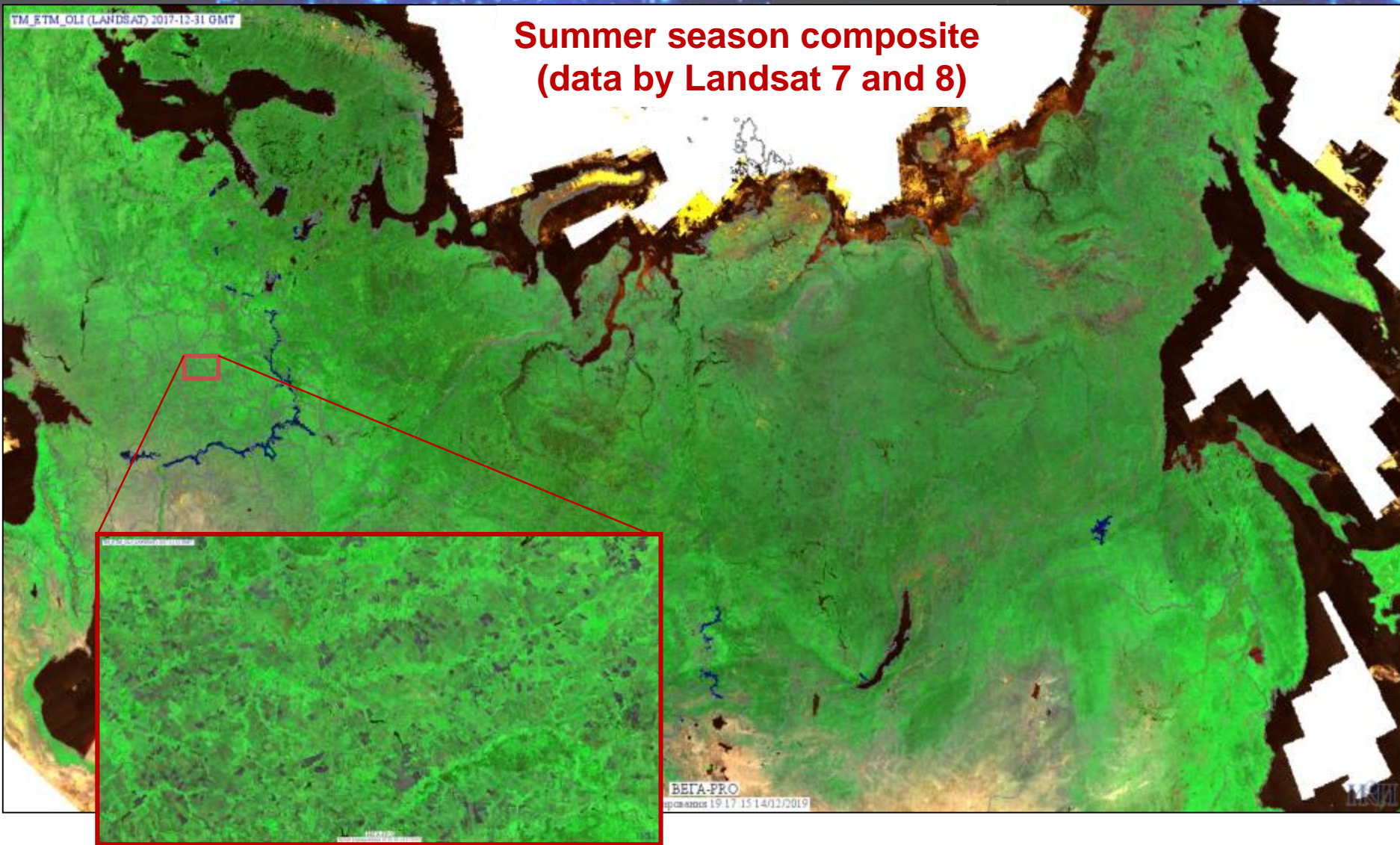
Cloud-free composite images at a resolution of 250-500 m are created for different observation periods: season, month, week, day.

Example of cloud-free composite image with Proba V (100 m)



Cloud-free composite images at a resolution of 50-100 m are created for different observation periods: season, month, week, day.

Example of cloud-free composite image with Landsat (30 m)



Cloud-free composite images at a resolution of 10-30 m are created for different observation periods: season, month, week, day (in construction).

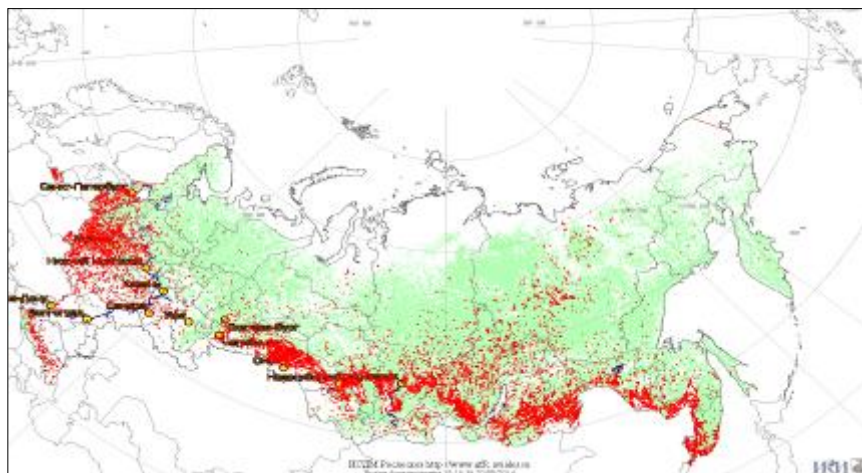
Level 4 products (different thematic products)



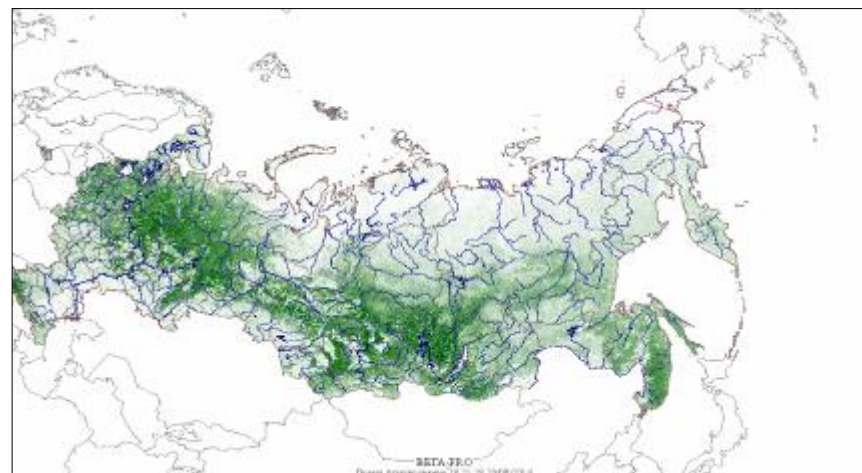
Maps of the vegetation cover in Russia.
Updated annually.



Maps of the dominant tree species.
Updated annually.



Information on forest natural fires and their consequences.
Updated daily



Trunk wood stocks.
Updated annually.

How can data be provided

- *Via “Vega-Science” system, together with satellite data processing and analysis tools*
- *Via software interfaces (APIs) that allow online access to the information from various scientific projects*
- *Automatically transferred for the various scientific projects*

VEGA Service <http://sci-vega.ru>

Rus | En



VEGA-Science
satellite based service for vegetation monitoring

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Username: Password:

Analysis of vegetation condition

- [Fields list](#)
- [Fields area statistics](#)
- [Map](#)

Analysis of vegetation condition in the region

- [Information bulletins](#)
- [Statistics data](#)

Fire situation

- [Daily reviews of wildfires in Russia\[rus\]](#)

Identified anomalies in the state of vegetation (press-release)

- [Condition of winter crops season 2014.\[rus\]](#)
- [Problems in the growth of spring crops. June 2013.\[rus\]](#)
- [Spring crops of 2013 year. Risks of damage of winter crops in European part of Russia in December 2012 continue to be confirmed. \[rus\]](#)

Welcome to VEGA-Science!

VEGA-Science - satellite service for collective use, oriented on information support of scientific studies on status and dynamics of biosphere and its interaction with other components of geosystem.

Development and support of service **VEGA-SCIENCE** is provided by the [Russian Academy of Sciences' Space Research Institute - IKI \(Department of Satellite Monitoring Technologies\)](#).

The service is based on long-term archives of satellite data and information products received on their basis, that characterizing vegetation cover conditions in the Northern Eurasia, including Russia and neighboring countries. There are data in the archives on any area of this territory since the beginning of the twenty-first century.

Service **VEGA-SCIENCE**, in particular, allows to analyze condition of vegetation cover using the time series of vegetation indices, its seasonal and long-term dynamics for any individual site or polygon specified by the user.

The main requirement for access to **VEGA-SCIENCE** is the agreement of its potential users on free disclosure of provided to the system information to all users of the service for scientific objectives. To realize applied commercial projects, create specialized monitoring systems of renewable biological resources and environment you can use options of satellite service [VEGA-PRO](#).

VEGA-SCIENCE today is a unique scientific installation (UNU "BS IKI-Monitoring"), which is part of the [Center for collective use of scientific equipment \(CCU\) "IKI-Monitoring"](#)

How to use the demo version of the service

To work with the demo version of **VEGA-SCIENCE** service log in with the username **demo** and password **demo**. [The demo version allows you to...](#)

VEGA-SCIENCE is one of the core services of [VEGA-CONSTELLATION](#) - a VEGA information systems family for vegetation monitoring using satellite remote sensing data.

News

2017-07-27

Add a final map of winter crops of the season 2016-2017 as of July 7, 2017.

2017-05-24

Add a map of winter crops of the season 2016-2017 as of May 12, 2017.

2017-04-20

Add a map of winter crops of the season 2016-2017 as of April 7, 2017.

2016-12-12

Add a map of winter crops of the season 2016-2017 as of December 5, 2016.

2016-11-09

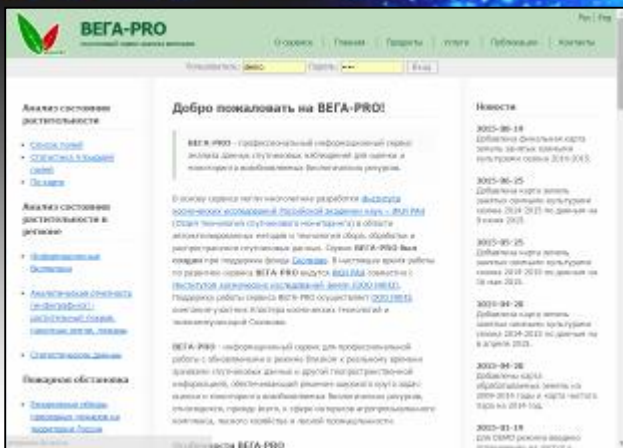
Add a map of winter crops of the season 2016-2017 as of November 3, 2016.

2016-10-24

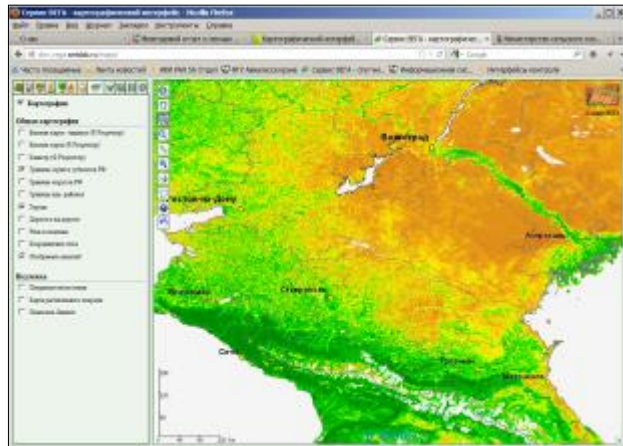
Add a map of winter crops of the season 2016-2017 as of October 11, 2016. While winter crops are well mapped over the center of European Russia due to their good state and enough time for emerging and development, sowing campaign in southern regions is still ongoing, affecting the accuracy of current crop map. It will be updated to follow plants development.

2016-10-13

VEGA-Science - service for information support of scientific studies on biosphere dynamics and its interaction with other components of geosystem based on EO data.



The VEGA-Science system is a tool for distributed work with satellite data (search, selection, processing and analysis) for a variety of scientific projects.



The service is based on archives of satellite data and results of their processing by IKI zone of interest.

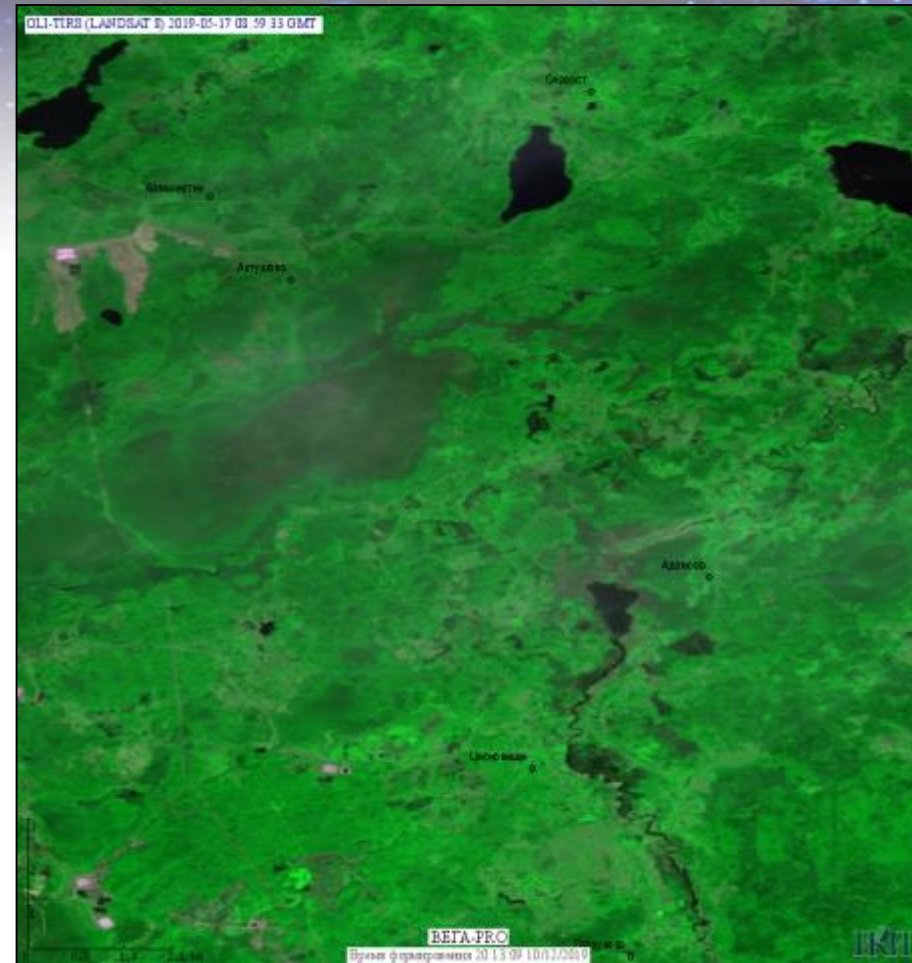


The system allows to work with both archive and operational data.

Possibility to conveniently obtain and analyze both historical and current data



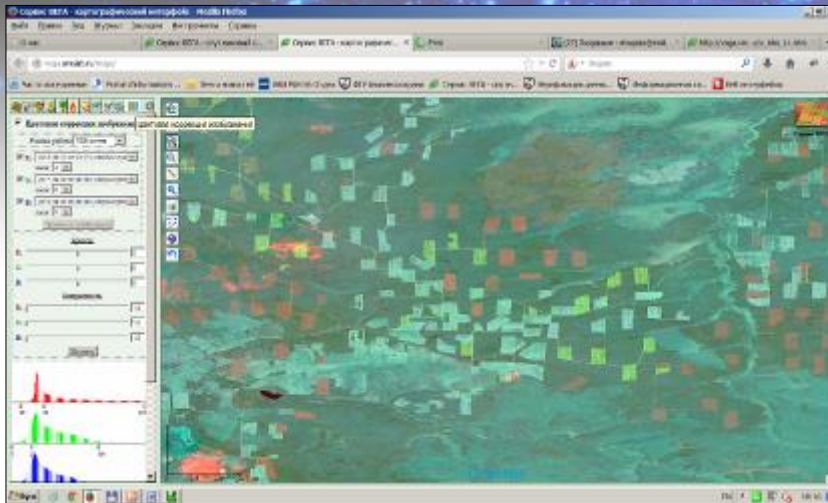
May 16, 1984. Landsat 5



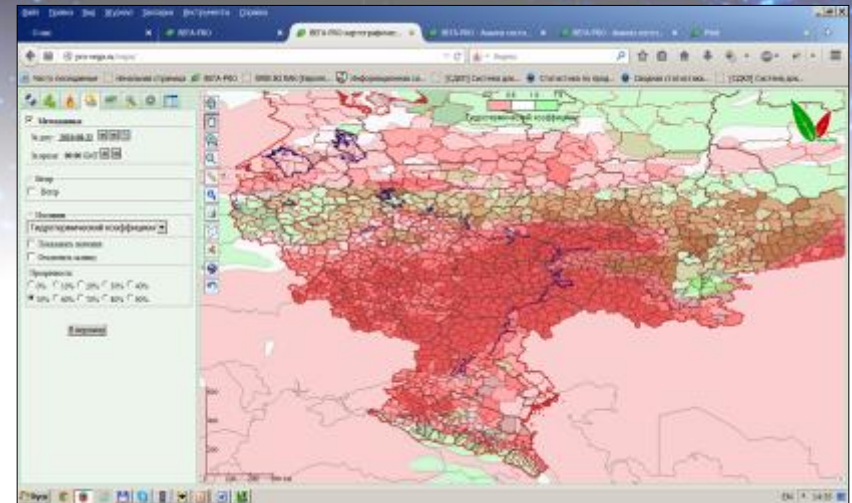
May 17, 2019. Landsat 8

**Change of land use structure in
Usvyatsky district, Pskov region**

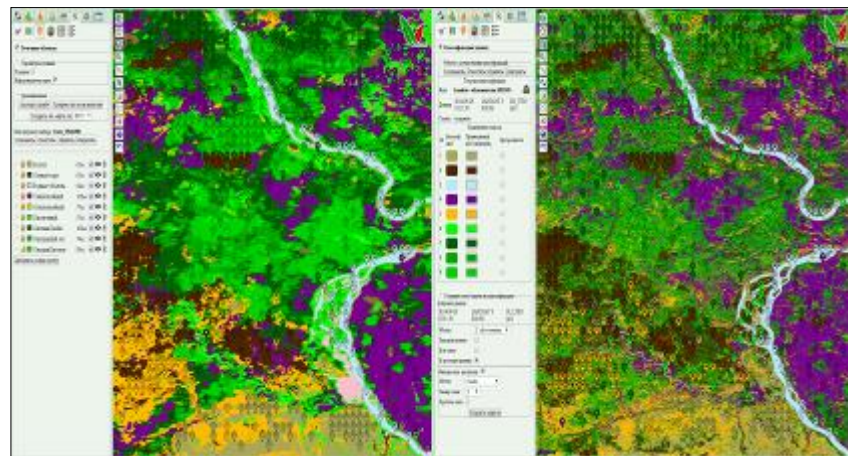
Examples of instruments



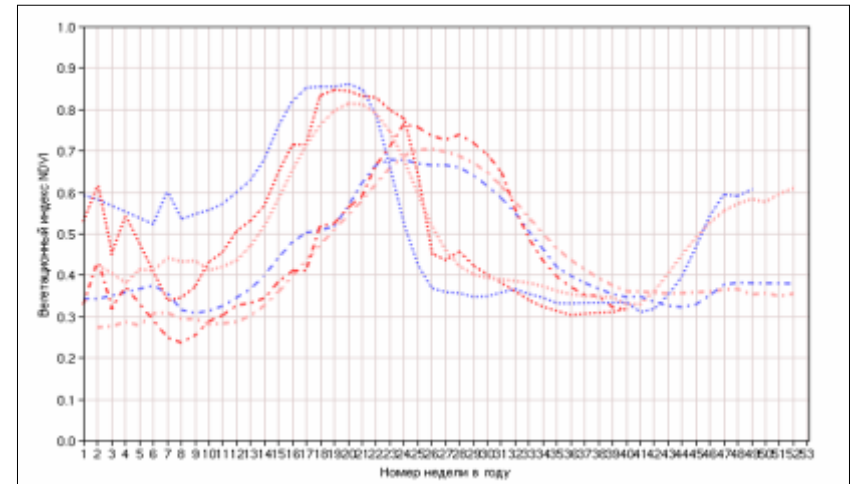
Analysis of multitemporal data



Joint analysis of different information



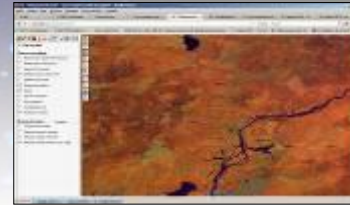
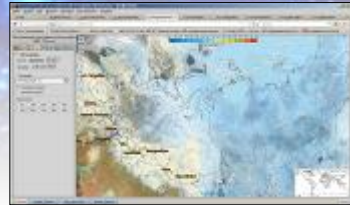
Data classification



Temporal data analysis

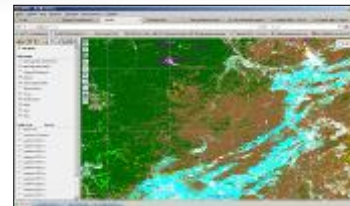
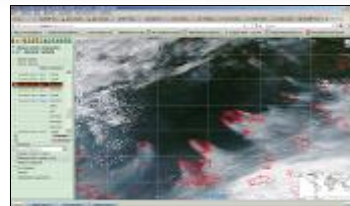
Examples of systems

System of work with remote hydrometeorological monitoring data
(ИС НИЦ «Планета» Росгидромета)



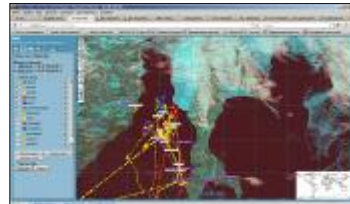
System of complex remote forest monitoring of Primorsky Krai
(ИС Вега-Приморье)

Remote monitoring of forest fires and their consequences
(ИСДМ-Рослесхоз)



ИС развития глобальной системы мониторинга сельского хозяйства
(ИС Вега-Geoglam)

Monitoring system for aquatic biological resources
(ОСМ Росрыболовства)



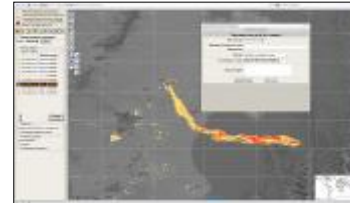
Global agricultural monitoring system development
(ИС Вега-Pro)

Agricultural Census Remote Control System
(МСКД ВСХД Росстат)



The System of Remote Study of the Border Seas of Russia
(ИС Sea The See)

Remote Agrometeorological Monitoring System
(ИС Вега-Агрометеоролог)



Volcanic activity monitoring system in Kamchatka and the Kurils
(ИС VolSatView)

VEGA-Geoglam Service

vega.geoglam.ru

Eng | Pyc

VEGA-GEOGLAM
web-based analysis for agriculture monitoring











SIGMA **GEOGLAM**
Global Agricultural Monitoring

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Registration : Username: demo Password: **** Enter

Map interface

SIGMA-JECAM test sites:

-  [Argentina - Antonio Areco](#)
-  [Belgium - Wallonia](#)
-  [Brazil - Para](#)
-  [Brazil - Sao Paulo](#)
-  [Brazil - Tocantins](#)
-  [Burkina Faso - Koumbia](#)
-  [Canada - Ontario](#)
-  [China - Heilongjiang](#)
-  [China - Shangdong](#)
-  [IRRI - Taishan](#)

Welcome to VEGA-GEOGLAM!

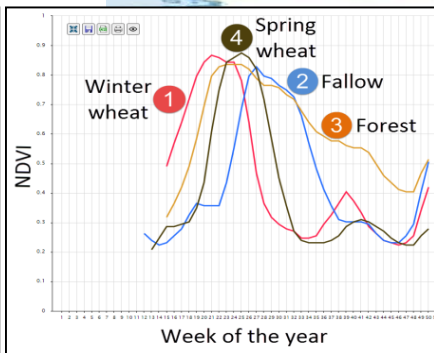
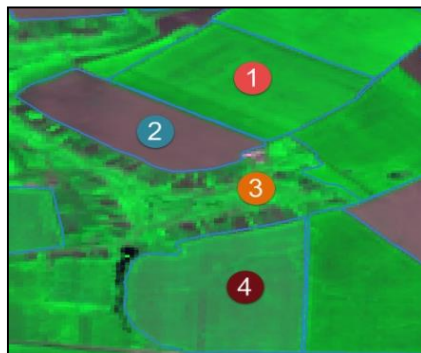
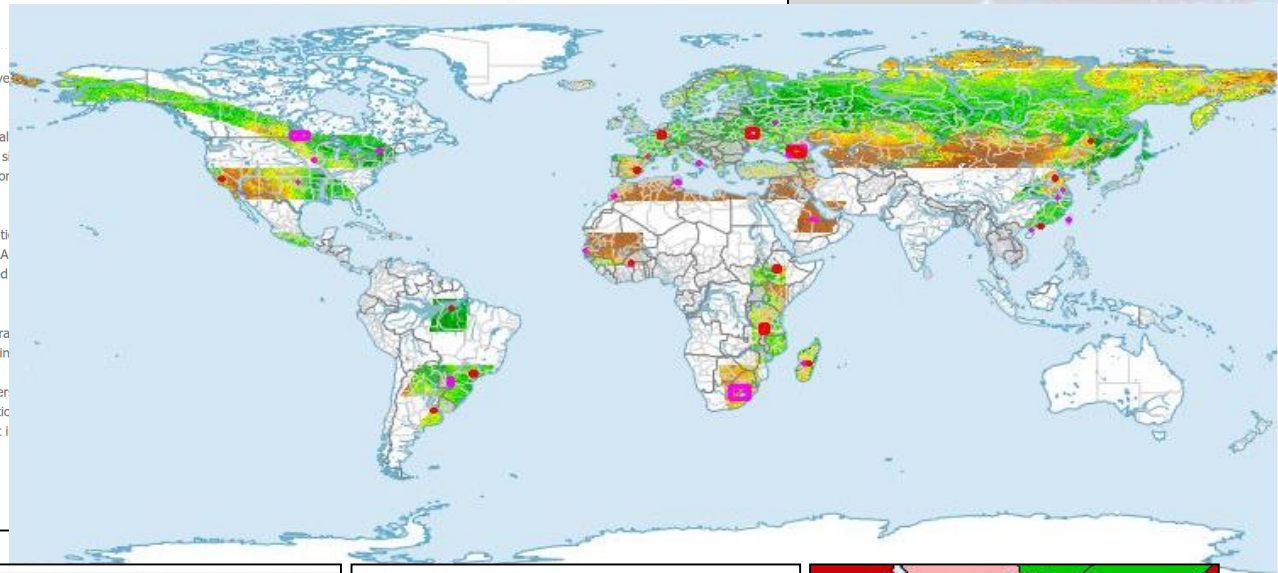
The VEGA-GEOGLAM web-based analysis system is developed in the framework of EC FP7 SIGMA project.

The VEGA-GEOGLAM is aimed at providing tools for analysis with particular focus at SIGMA-JECAM test sites implemented using the concept of geospatial information sources and providing access to users worldwide.

The VEGA-GEOGLAM is providing access to high-resolution data along with various derived products. The VEGA-GEOGLAM DEIMOS data and other geospatial information collected from MODIS and Landsat satellite data with daily update.

The VEGA-GEOGLAM is focused at facilitating agricultural seasonal and multi-annual dynamics at every single point.

This tool is hence mainly positioned towards the partner countries of this pre-processed data for a wider community. In particular, monitoring of agricultural production and yield forecast is



Field info

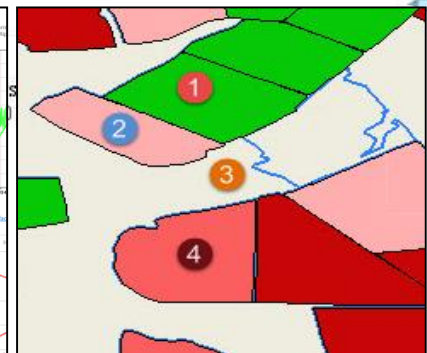
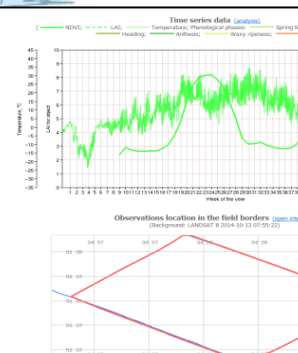
Field ID: 0015_00_010
Description: 3,37 x 3,36
Country: Romania
Region: Banat
District: Lugoj
User name: 001_Agri
Start date: 2010-05-26

Information about land usage

Year classification: 2010, type of use: arable lands
Automatic classification: 001_001_001

Crops information

Year	Crop	Productivity
2010	crop: Corn for grain	10.0 t/ha
2011	crop: Winter wheat	10.0 t/ha
2012	crop: Spring barley	10.0 t/ha
2013	crop: Corn for grain	10.0 t/ha
2014	crop: Winter wheat	10.0 t/ha
2015	crop: Spring barley	10.0 t/ha
2016	crop: Corn for grain	10.0 t/ha
2017	crop: Winter wheat	10.0 t/ha
2018	crop: Spring barley	10.0 t/ha
2019	crop: Corn for grain	10.0 t/ha
2020	crop: Winter wheat	10.0 t/ha
2021	crop: Spring barley	10.0 t/ha
2022	crop: Corn for grain	10.0 t/ha



VEGA-GEOGLAM is global agricultural monitoring service aimed to perform EO and in-situ data analysis over JECAM test-sites

Vega-Science today



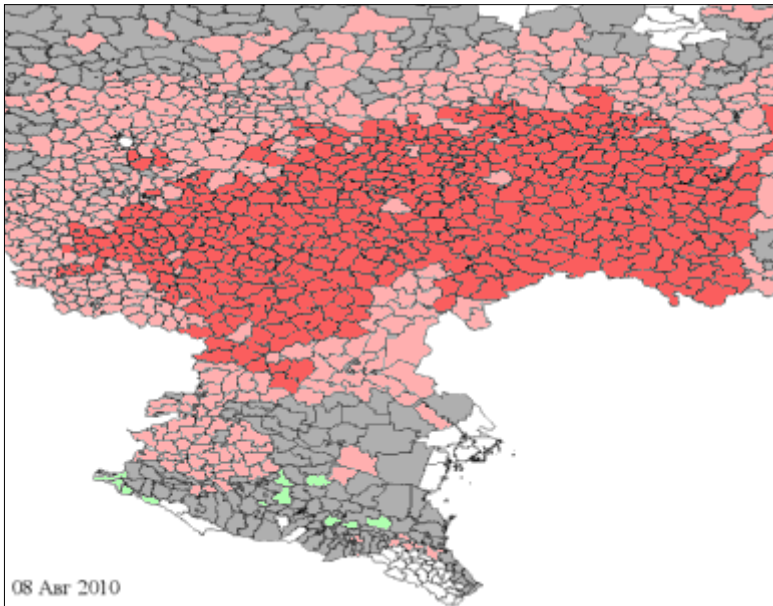
By the amount of data available for operation

One of the ten in the world (after USGS, NOAA, GOOGLE, ESA, CNSA)

According to online data (over 3 Pb)

Close to the world's top five (after USGS, NOAA, GOOGLE)

In terms of the capabilities of online data analysis tools - one of the three in the world (comparable to GOOGLE EARTH ENGINE)



Developments and future

- *Development of new tools, services and systems for solving various scientific tasks and providing scientific projects*
- *Development of technologies for distributed work with Earth remote sensing data from Space*
- *New thematic information products formed on the basis of remote sensing data (first of all "automatic")*
- *Development of specialized distributed information nodes*

VEGA Service <http://sci-vega.ru>

Rus | En



VEGA-Science
satellite based service for vegetation monitoring

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- [Spring crops of 2013 year. Risks of damage of winter crops in European part of Russia in December 2012 continue to be confirmed.](#) [rus]

Welcome to VEGA-Science!

VEGA-Science - satellite service for collective use, oriented on information support of scientific studies on status and dynamics of biosphere and its interaction with other components of geosystem.

Development and support of service **VEGA-SCIENCE** is provided by the [Russian Academy of Sciences' Space Research Institute - IKI \(Department of Satellite Monitoring Technologies\)](#).

The service is based on long-term archives of satellite data and information products received on their basis, that characterizing vegetation cover conditions in the Northern Eurasia, including Russia and neighboring countries. There are data in the archives on any area of this territory since the beginning of the twenty-first century.

Service **VEGA-SCIENCE**, in particular, allows to analyze condition of vegetation cover using the time series of vegetation indices, its seasonal and long-term dynamics for any individual site or polygon specified by the user.

The main requirement for access to **VEGA-SCIENCE** is the agreement of its potential users on free disclosure of provided to the system information to all users of the service for scientific objectives. To realize applied commercial projects, create specialized monitoring systems of renewable biological resources and environment you can use options of satellite service [VEGA-PRO](#).

VEGA-SCIENCE today is a unique scientific installation (UNU "BS IKI-Monitoring"), which is part of the [Center for collective use of scientific equipment \(CCU\) "IKI-Monitoring"](#)

How to use the demo version of the service

To work with the demo version of **VEGA-SCIENCE** service log in with the username **demo** and password **demo**. [The demo version allows you to...](#)

VEGA-SCIENCE is one of the core services of [VEGA-CONSTELLATION](#) - a VEGA information systems family for vegetation monitoring using satellite remote sensing data.

News

2017-07-27

Add a final map of winter crops of the season 2016-2017 as of July 7, 2017.

2017-05-24

Add a map of winter crops of the season 2016-2017 as of May 12, 2017.

2017-04-20

Add a map of winter crops of the season 2016-2017 as of April 7, 2017.

2016-12-12

Add a map of winter crops of the season 2016-2017 as of December 5, 2016.

2016-11-09

Add a map of winter crops of the season 2016-2017 as of November 3, 2016.

2016-10-24

Add a map of winter crops of the season 2016-2017 as of October 11, 2016. While winter crops are well mapped over the center of European Russia due to their good state and enough time for emerging and development, sowing campaign in southern regions is still ongoing, affecting the accuracy of current crop map. It will be updated to follow plants development.

2016-10-13