RUSSIAN FEDERATION

RUSSIAN FEDERAL SPACE AGENCY

INITIATIVES OF FEDERAL SPACE AGENCY ON USAGE OF REMOTE SENSING DATA IN THE INTERESTS OF SUSTAINABLE DEVELOPMENT

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RUSSIAN REMOTE SENSING ORBITAL CONSTELLATION IN 2014:

- "Resurs-P” № 1 and № 2 with high resolution (better than 1 meter) optical sensor, wide capture multispectral optical sensors (with high – 12 meters and medium – 60 meters resolution) and hyperspectral optical sensor (with 30 meters resolution)

- “Kanopus-V" with panchromatic optical system (with 2.5 meters resolution) and a multispectral optical system (with 12 meters resolution/

- Hydro-meteorological satellite "Meteor-M” № 1 and № 2 (with 50-70 meters resolution and 1000 kilometers swath width). It’s also used for global monitoring of the Russia territory for 2 or 3 days

- Hydro-meteorological geostationary space complex "Elektro-L” № 1 with the every 30 minutes global observation of the Earth

- "Resurs-DK“ with 2-5 meters resolution equipment

REMOTE SENSING DATA APPLICATION

Monitoring of Olympic Construction in Sochi Using Russian Remote Sensing Data*

For seven years, the Research Center for Earth Operative Monitoring proactively monitored the Olympic construction in the Greater Sochi. Analysis of multi-temporal high-resolution satellite data enabled assessing dynamics of the Olympic construction.

Sochi Olympic Park is the heart of the Coastal Cluster. It includes various sport venues, Olympic Park area and infrastructure facilities. For the first time in the history of Winter Olympic and Paralympic Games all ice areas were located within walking distance. The capacity of the park allows for simultaneous presence of approximately 75 thousand visitors.

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*Data used:
Resurs-DK, Kanopus-V and Resurs-P1 of 1 – 4 m resolution

Monitoring of Olympic Construction in Sochi Using Russian Remote Sensing Data*

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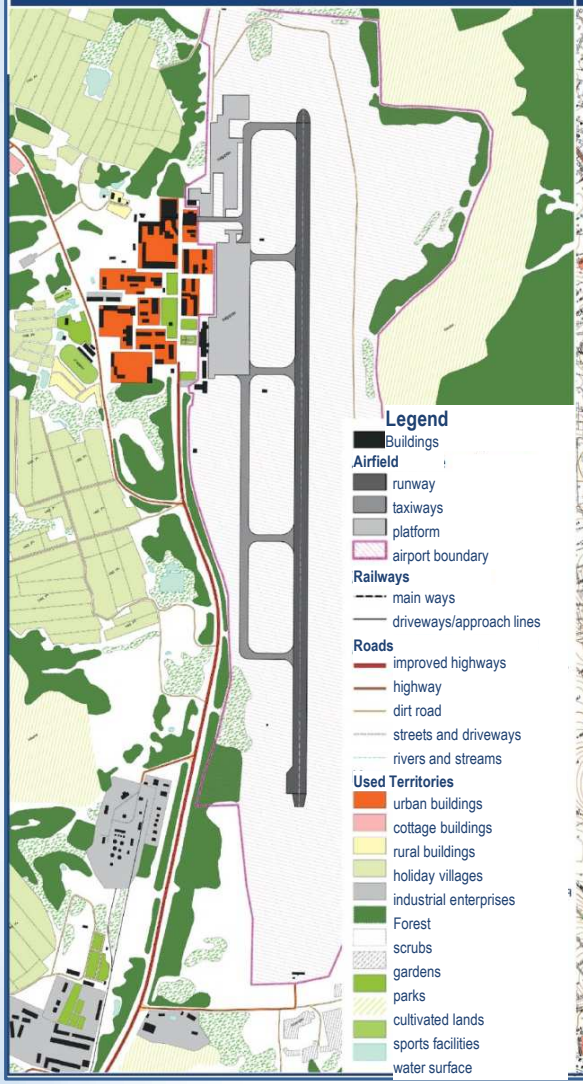
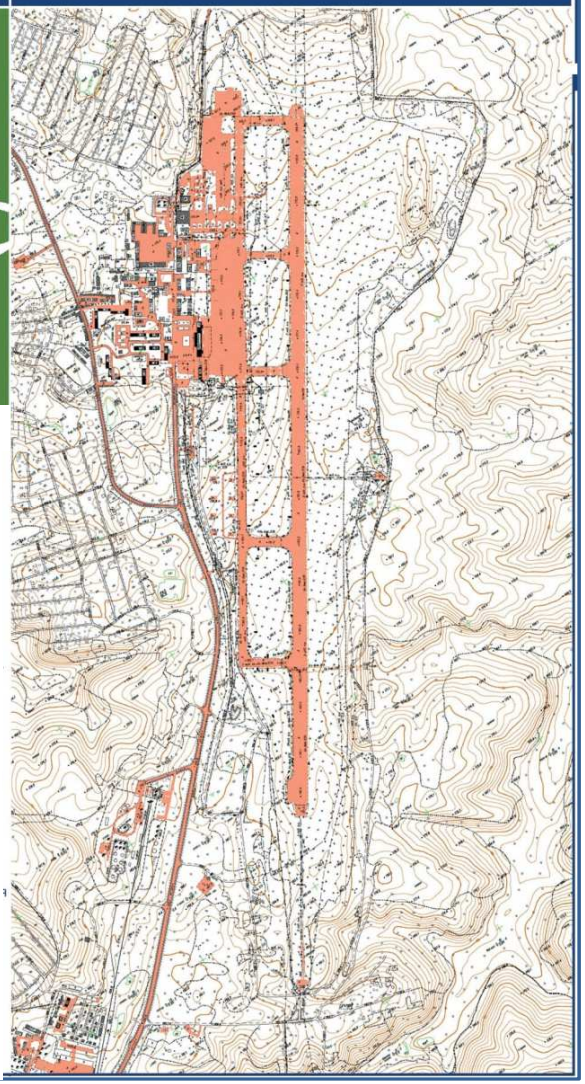
*Data used:
Resurs-DK and Resurs-P1 of 1 – 4 m resolution

Current State of Territory Plan



Engineering and Topographic Plan



Creating a Topographic Plan of Bogashevo Airport, Tomsk

Using Remote Sensing Data*

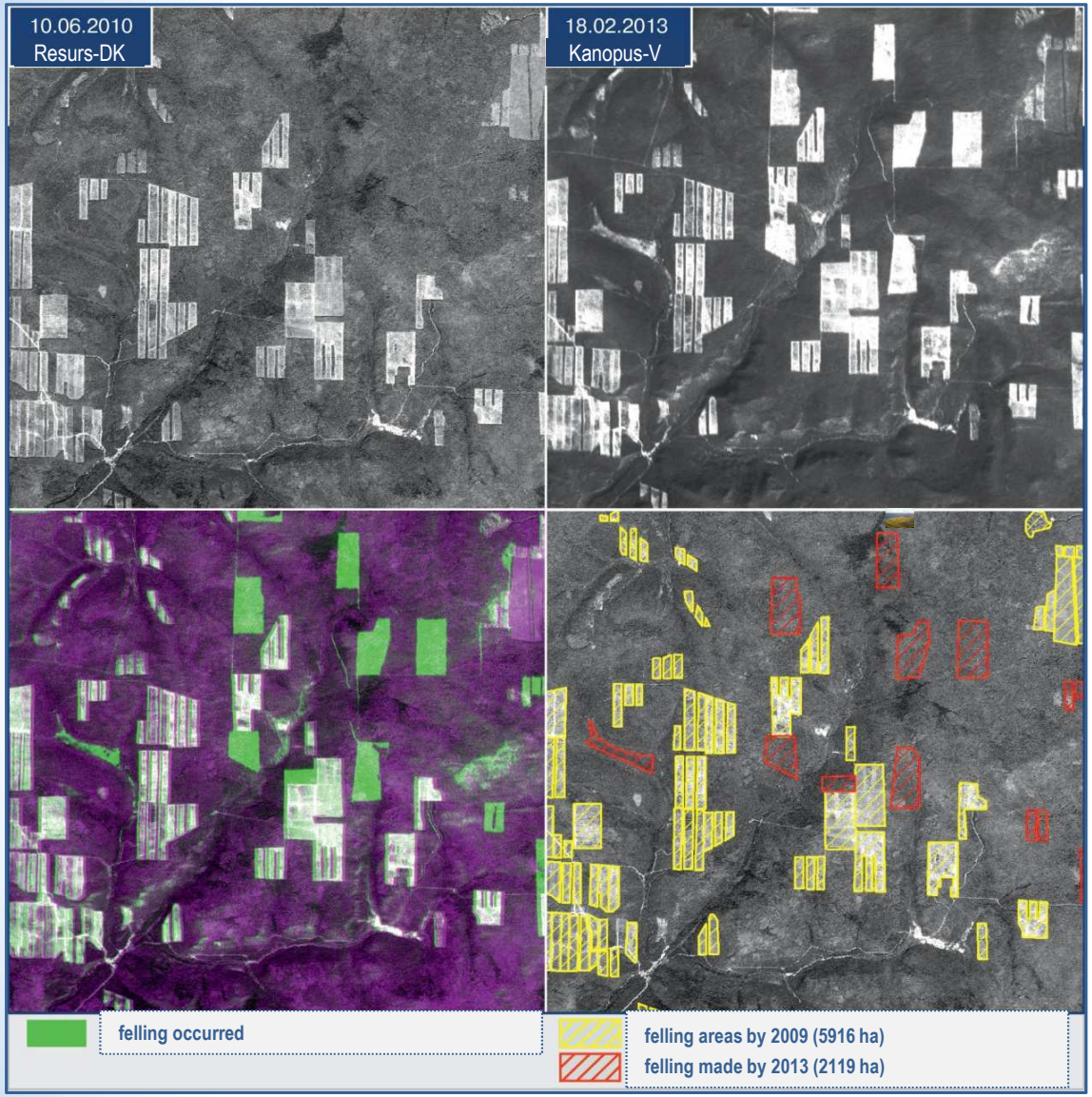
In 2011, the Research Center for Earth Operative Monitoring mapped the area of Bogashevo Airport (Tomsk, Russia) at a scale of 1:5000 for the CJSC Petersburg-Dorservice.

The outcomes of the mapping include:

- Digital layout of the airport and its current condition;
- Digital engineering and topographic plan of the airport;
- Digital elevation model

*Data used:

- Resurs-DK of 1 m resolution (10.05.2010);
- Stereo pair of WorldView-1 of 0.5 m resolution (11.09.2011);
- Ground control points with the GPS measurements-based coordinates in the local coordinate system (given by the customer)



Deforestation Monitoring*

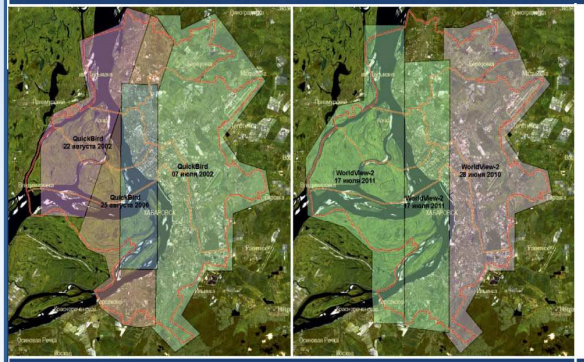
Irkutsk Region

The state-of-the-art remote sensing facilities enable acquiring operative and reliable data on forest condition and economic activity over any territory. Illegal logging causes enormous damage to forest and economy. The monitoring based on remote sensing data enables detecting and specifying the felling made over a specific period of time and determining felling area and coordinates.

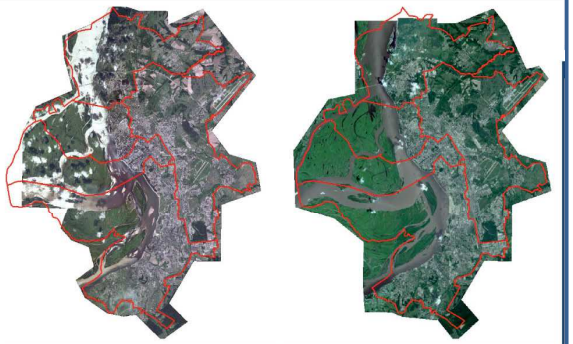
*Data used:
- Resurs-DK of 1 m resolution;
- Kanopus-V with 2.7 m resolution

THEMATIC PROJECTS

Scheme of QuickBird and WorldView-2 Data Coverage



Space Image Mosaics, Khabarovsk City over the Periods 2002-2007 and 2010-2011



Normalized difference Vegetation Index (NDVI) Over the Periods 2002-2007 and 2010-2011 (Fragments)

Digital Elevation Model

Layer of Horizontals

Generation of Green Plantation Vector Layer (fragments)

Thematic Layer of Green Plantations Over the Period 2002-2007

Thematic Layer of Green Plantations Over the Period 2010-2011

Thematic Layer of Green Plantations Changes Over the Period 2002-2011

Green Plantations Assessment, Khabarovsk*

In 2013, the investigations in the environmental control and natural resources assessment of Khabarovsk were pursued for the Khabarovsk Authorities by the Research Center for Earth Operative Monitoring.

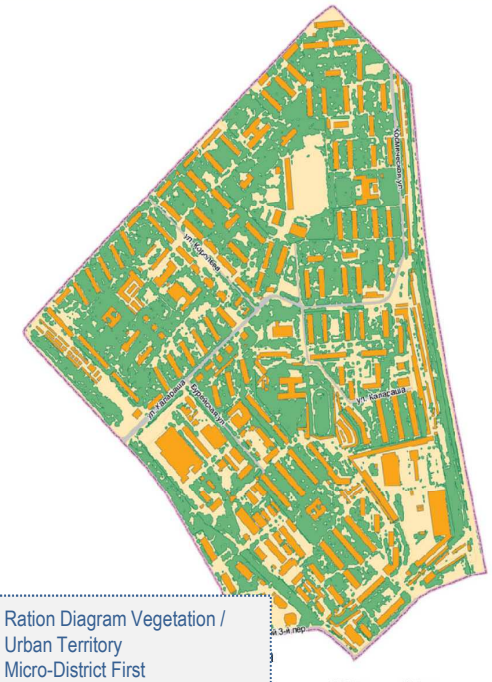
Investigation Results:

- Production of digital schematic map of Khabarovsk city current status;
- Generation of digital elevation model;
- Determination of urban plantation areas for the periods 2002-2007 and 2010-2011;
- Comparative analysis of plant resources for the stated period of time both for the city in whole and for separate administrative districts;
- Acquiring the data on provision of Khabarovsk and administrative districts with green plantations and calculation of provision of inhabitants with green per capita;
- Assessment of green plantation provision of some historic districts and micro-districts of new housing construction.

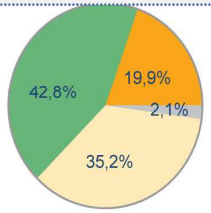
*Data used:

- The main information source of green plantations' assessment – QuickBird (2.44 m resolution) and WorldView-2 (1,84 resolution) data over the periods of active vegetation (June-August) 2002-2007 and 2010-2011;
- ASTER / Terra stereo pair images of 15 m resolution.

Example of Green Plantation Provision of Micro-District First



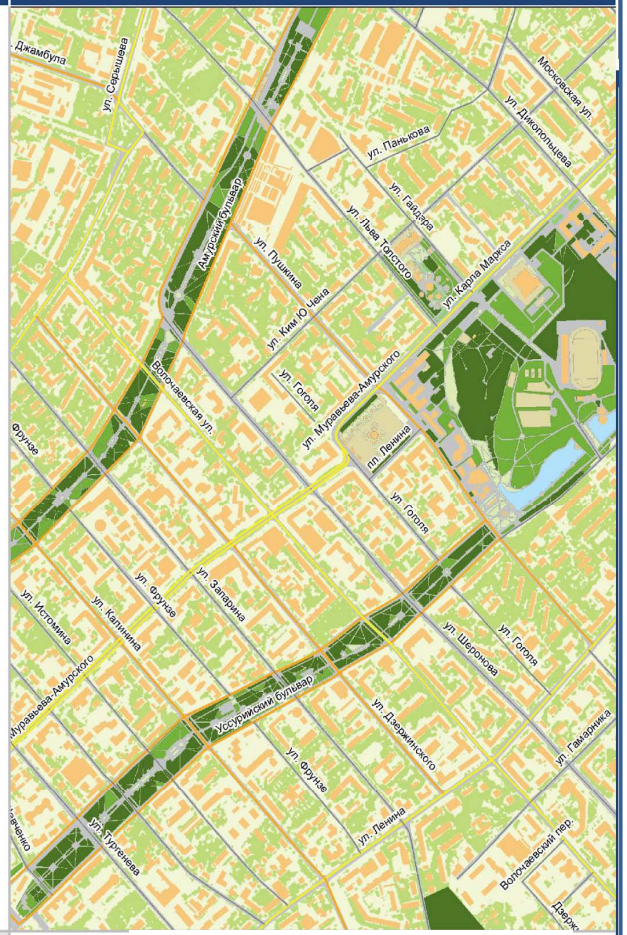
Ration Diagram Vegetation / Urban Territory Micro-District First



District area	1336641,7 м²
Vegetation area	571697,8 м²

buildings
green plantations
streets and drive-ways
other territories

Schematic Map of Khabarovsk Territory Use (Fragment)



Green Plantations Assessment, Khabarovsk*

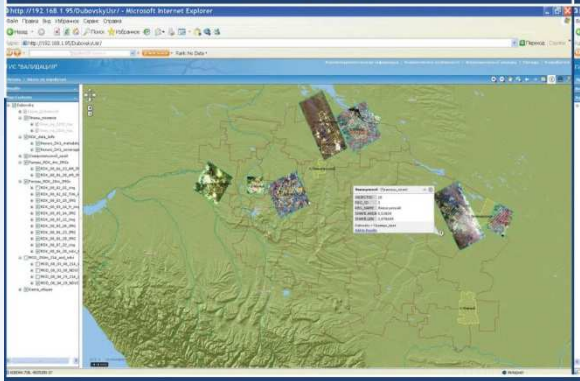
In 2013, the investigations in the environmental control and natural resources assessment of Khabarovsk were pursued for the Khabarovsk Authorities by the Research Center for Earth Operative Monitoring.

District	Changes in Green Plantation Area (m²)	Changes in Green Plantations Area in %	Changes in Green Plantations Provision per capita (m²/person)
Zhelezodorozhniy	+2696885.0	+2.7	+16.9
Industrialniy	+579025.9	+0.4	0.0
Kirovskiy	+2961984.9	+7.4	+68.1
Krasnoflotskiy	+2140348.2	+2.9	+27.7
Tsentralniy	+6143499.2	+11.8	+65.5

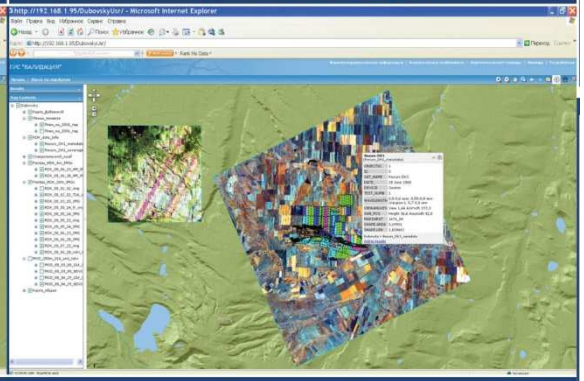
*Data used:
- The main information source of green plantations' assessment – QuickBird (2.44 m resolution) and WorldView-2 (1,84 resolution) data over the periods of active vegetation (June-August) 2002-2007 and 2010-2011;
- ASTER / Terra stereo pair images of 15 m resolution.

THEMATIC PROJECTS

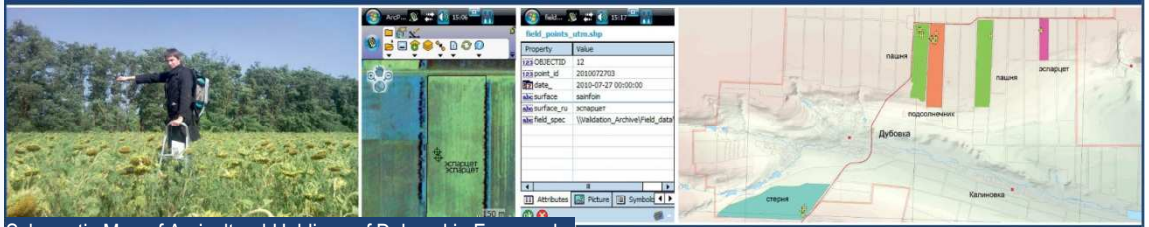
Access to GIS via Web Browser



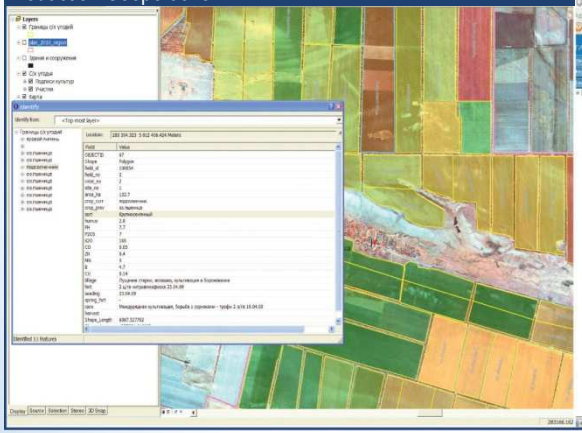
Resurs-DK Data Characteristics



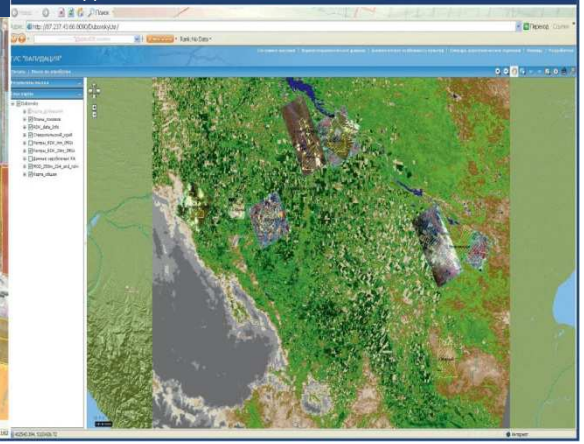
Сбор и подготовка наземных данных



Schematic Map of Agricultural Holdings of Dubovskiy Farm and Production Cooperative



Web Application



Developing an Agricultural Geoinformation System of Dubovskiy Agricultural Production Cooperative*

Stavropol Territory

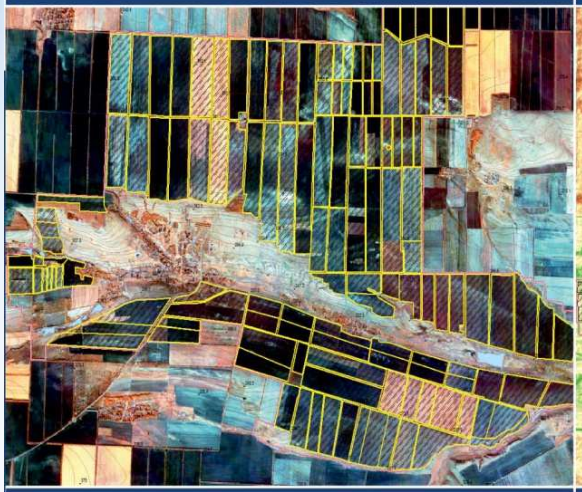
As a part of the Validation Work, the basic elements of the experimental test site and the GIS basic model were constructed by the Research Center for Earth Operative Monitoring. The developed GIS consists of two web applications generated within the unified service and with central control. They operate with common geospatial database, have the GIS functionality and support a great number of users. The satellite data, planting plans, farm boundary land use map of the Dubovskiy test site and general data on the Stavropol Territory such as decade agro-meteorological overview, sheets and relevant data are downloaded to the GIS database. During the working process, spectral measurements were proceeded in the test site. They were intended to develop and exercise the satellite data intercalibration methods.

The Russian Resurs-DK data was used as a main map material in production of general cartographic base and to acquire semantic information.

*Data used:

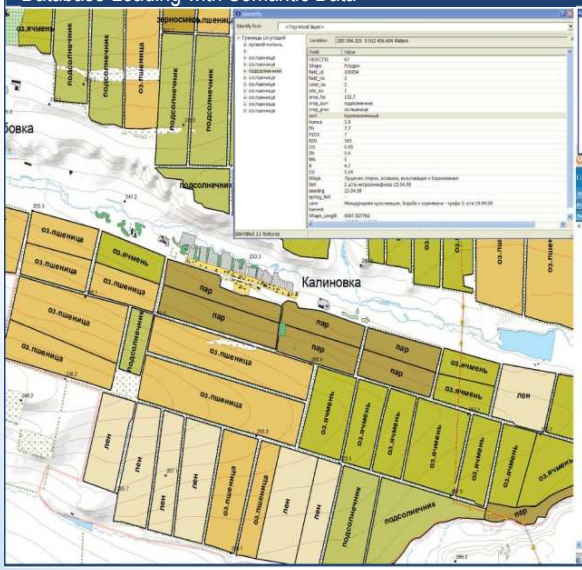
- Meteor-M1 of 60 m resolution;
- Resurs-DK of 1 m resolution;
- SPOT of 10 m resolution;
- ALOS of 7/10 m resolution;
- Field observations acquired in cooperation with Federal State Institution Agrochemical Service Center Stavropolskiy

Resurs-DK image

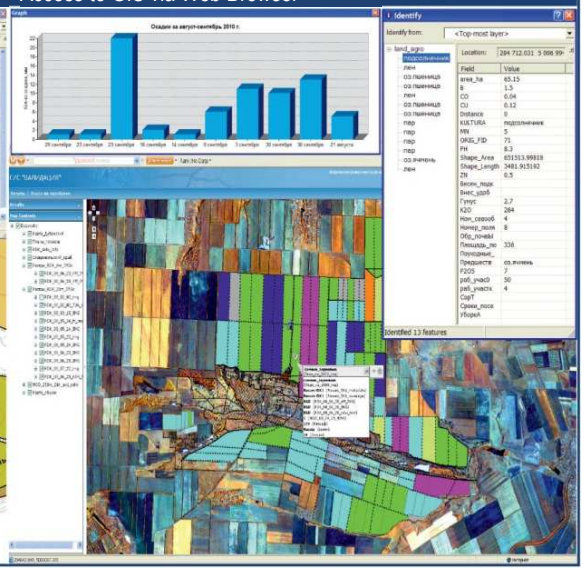


Agricultural Crops Condition According to NDVI (June)

Database Loading with Semantic Data



Access to GIS via Web Browser



Developing an Agricultural Geoinformation System of Dubovskiy Agricultural Production Cooperative*

Stavropol Territory

In order to estimate the agricultural crop condition, the Normalized Difference Vegetation Index (NDVI) was calculated. The NDVI calculated for different dates of the entire vegetation period is used to study the seasonal dynamics of vegetation and to observe its phenological changes. During the period March-September, the planned observations of agricultural crops comprising the test site were carried out and times and phases of vegetation development were registered. The planned soil and plant sample selection and chemical analysis were performed. The data on condition and characteristics of agricultural crops on the test site were entered into the database and are available now for overview by the Web application developed. The GIS of test site network was developed and brought into pilot operation. The GIS is designed for storage, visualization and remote access to geospatial database and ground-based measurements that describe the test via the Internet using the web applications.

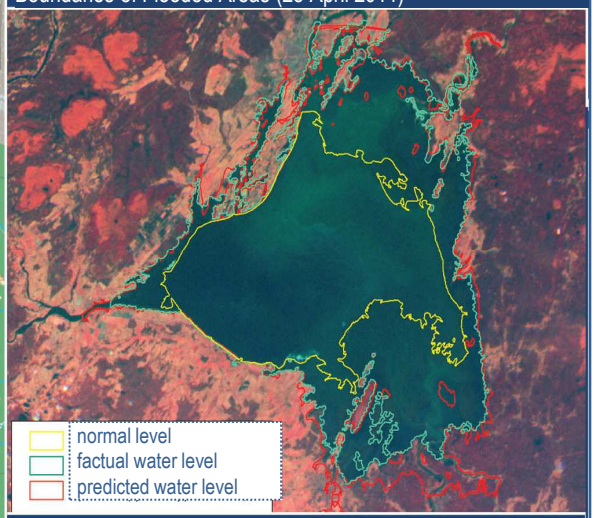
*Data used:

- Meteor-M1 of 60 m resolution;
- Resurs-DK of 1 m resolution;
- SPOT of 10 m resolution;
- ALOS of 7/10 m resolution;
- Field observations acquired in cooperation with Federal State Institution Agrochemical Service Center Stavropolskiy

Verification of Mathematical Models of Inundations and Floods Based on Remote Sensing Data*

Novgorod Region

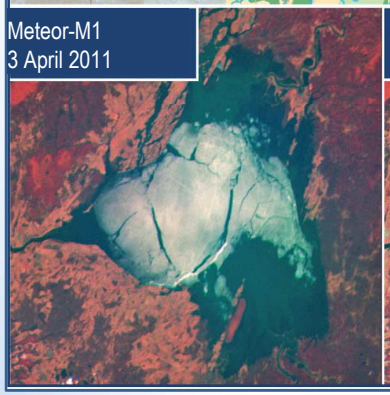
Boundaries of Flooded Areas (28 April 2011)



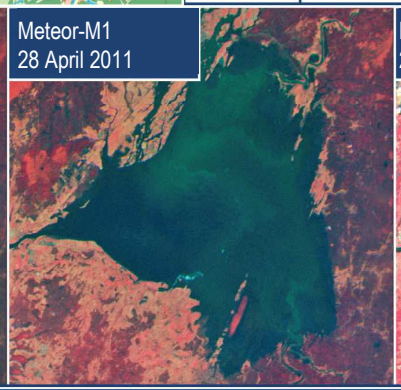
Verification Results

Date	Simulated Area, km2	Actual Area, km2	Difference, km2	Deviation, %
23.04.2011	1796	1764	-32	2
28.04.2011	1988	1852	-136	7
22.05.2011	1997	1692	-305	18

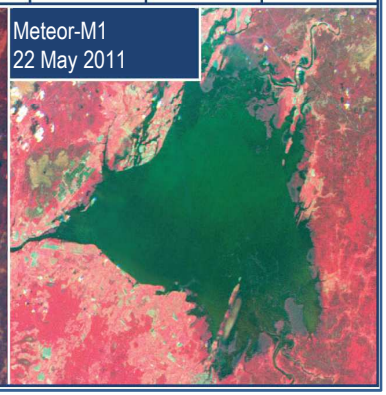
Meteor-M1
3 April 2011



Meteor-M1
28 April 2011



Meteor-M1
22 May 2011



In 2012, within the framework of developing the Special-Purpose System of Water Industry Monitoring the thematic geospatial data sets were generated and mathematical models of floods and inundations were verified by the Research Center for Earth Operative Monitoring using remote sensing data.

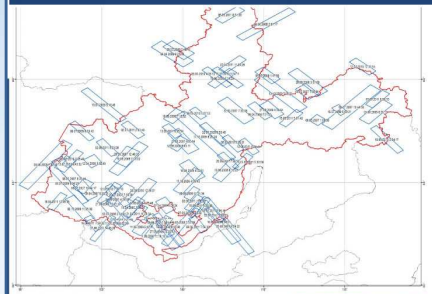
The mathematical simulation of Lake Ilmen flood yielded satisfactory results. For purposes of verification 8 models corresponding to three seasons (2010-2012) were presented which may be considered as systematic monitoring. The difference between the simulated and actual flood area therewith has approximately the same number of both positive and negative values suggesting that the error is random and the mean deviation of estimated flood are from the actual one is 14%. This leads to a conclusion that the mathematical model corresponds to the factual data.

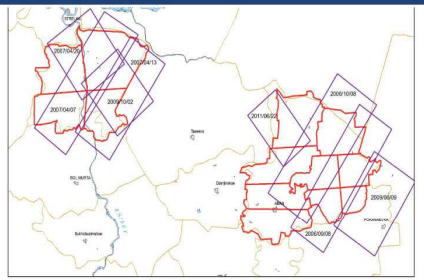
*Data used:

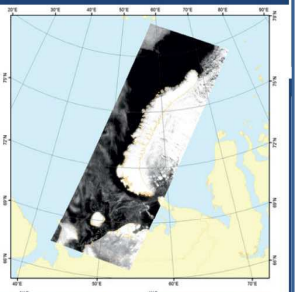
- Landsat 7 of 15 m resolution;
- Meteor-M1 of 60 m resolution;
- Resurs-DK of 1 m resolution
- Flood and inundation models built by St. Petersburg State Hydrological Institute.

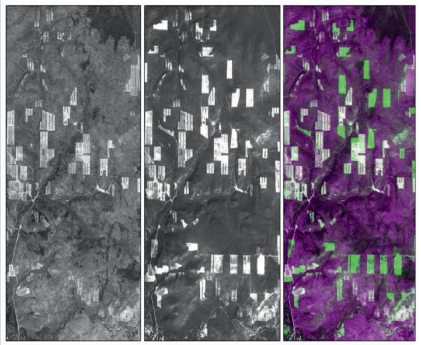
THEMATIC PROJECTS

Some of the Outcomes of ZAPAS (Forest Resources Assessment and Monitoring under the Framework of the EU-Russian Dialogue) and MAIRES (Monitoring of the Arctic Land and Sea Ice Using Data from Russian and European Satellites) Projects

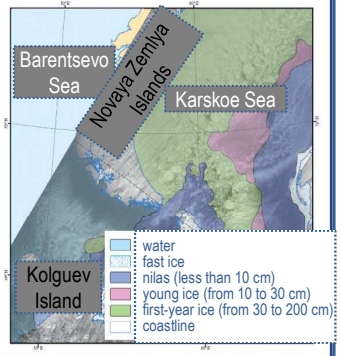


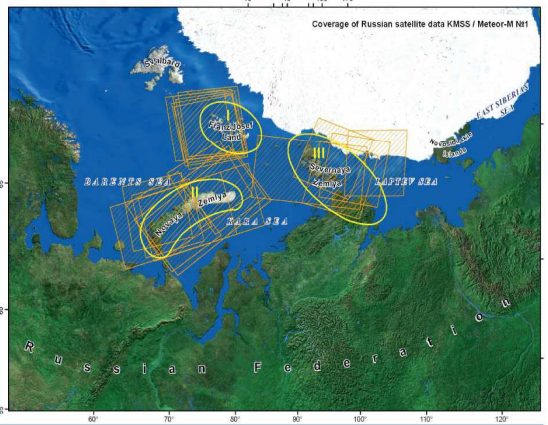






SEVENTH FRAMEWORK PROGRAMME





Satellite data

System	Instrument	Information	Coverage (quicklook and shape file)	Data
Resurs-O1 #2	MSU-E			
Resurs-O1 #3	MSU-E			
Resurs-O1 #4	MSU-E			
Meteor-3M #1	MSU-E			
Okean-O #1	MSU-SK			
Monitor-E	PSA			
Monitor-E	RDSA			
Meteor-M1	KMSS			
Meteor-M1	BRLK			

Participation in International Projects of the EC FP7*

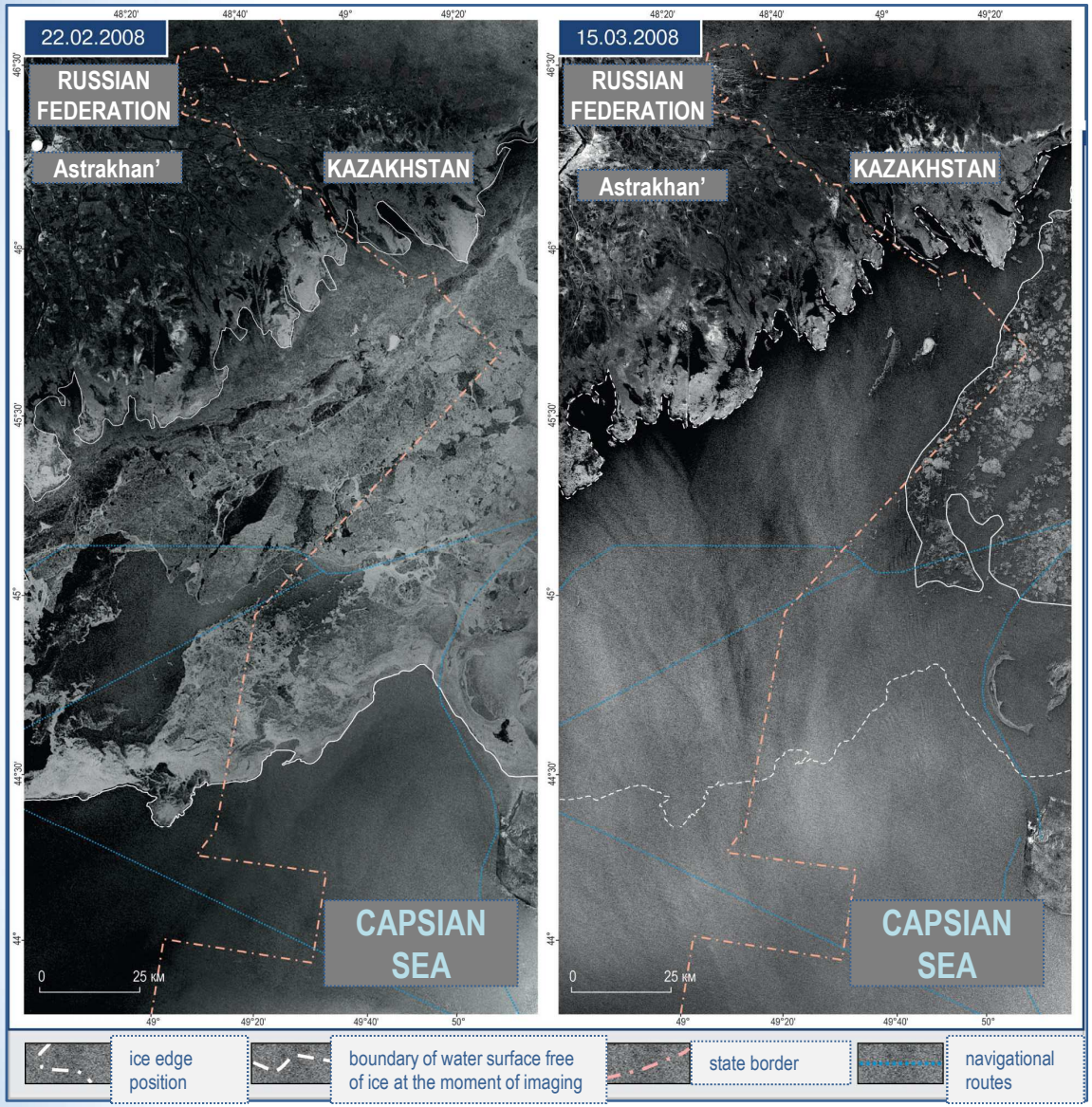
Since 2011, the Research Center for Earth Operative Monitoring has participated in the implementation of two international projects under the Seventh Framework Program of European Commission.

These projects demonstrate the benefits of sharing remote sensing data obtained from Russian and European Satellites.

These projects include study, cross validation and improvement of the existing optical algorithms to obtain data on the condition of terrain as well as research on innovative synergetic approaches to generating geoinformation monitoring products.

*Data used:

- Meteor-M1 of 60 m resolution;
- Resurs-DK of 1 m resolution;
- Monitor-E of 20 m resolution;
- Monitor-E of 8 m resolution;
- Meteor-3M of 30 m resolution;
- Resurs-O1 № 2 of 45 resolution;
- Resurs-O1 № 3 of 45 resolution;
- Resurs-O1 № 4 of 30 resolution

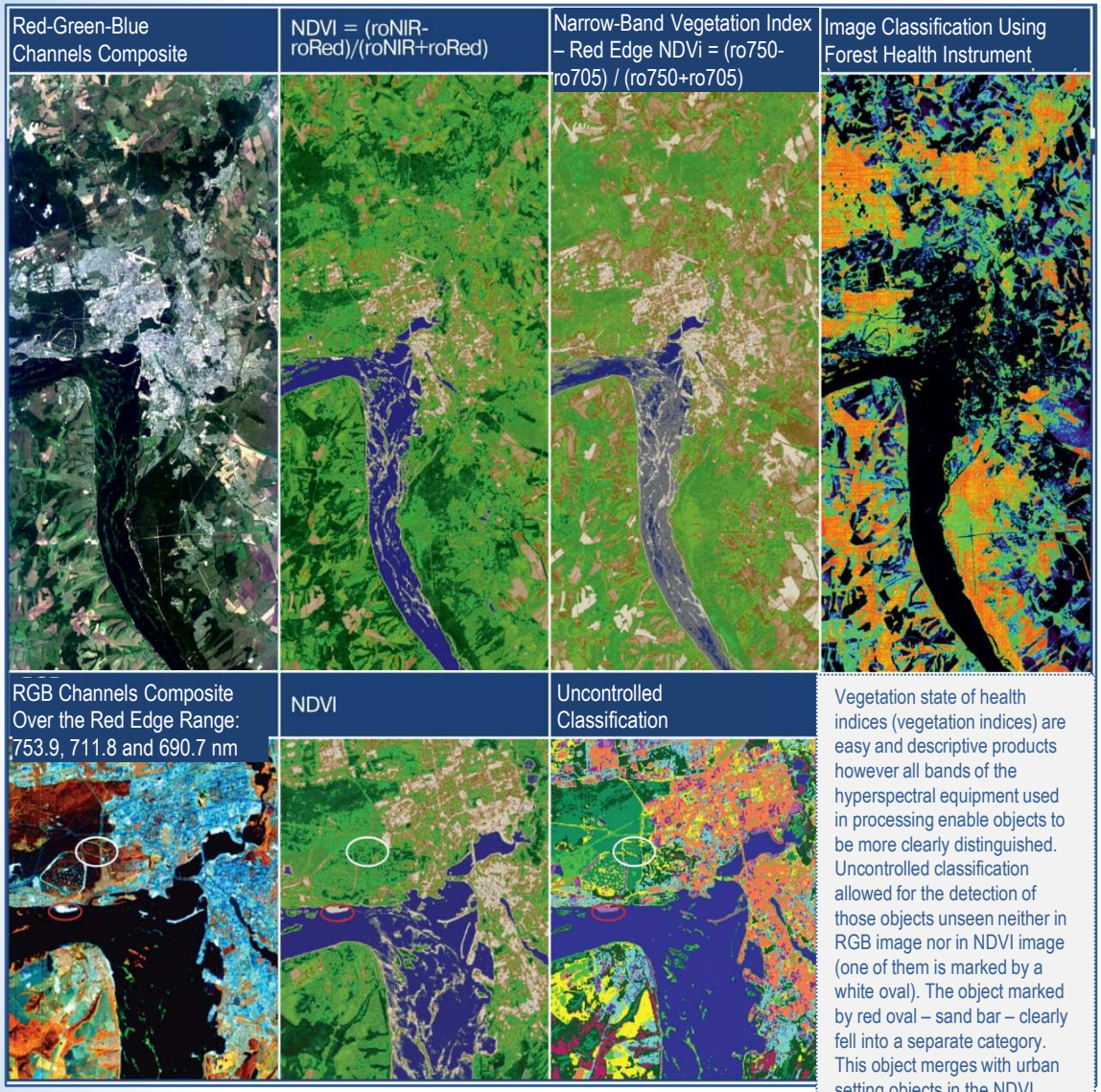


Ice Conditions Monitoring*

Northern Part of the Caspian Sea

Satellite radar data is used for navigation and ice condition observation in operational ice cover monitoring and coastline variability research in fall, winter and spring. It allows detecting stages of water surface freezing and its freeing from ice.

*Data used:
ENVISAT ASAR (02.06.2008)
© European Space Agency (2008)



Vegetation state of health indices (vegetation indices) are easy and descriptive products however all bands of the hyperspectral equipment used in processing enable objects to be more clearly distinguished. Uncontrolled classification allowed for the detection of those objects unseen neither in RGB image nor in NDVI image (one of them is marked by a white oval). The object marked by red oval – sand bar – clearly fell into a separate category. This object merges with urban setting objects in the NDVI image.

Elaborating Tools and Methods for Value-Added Use of Hyperspectral Data*

Kazan City

Hyperspectral imaging is the most advanced technique of 'space vision' that makes it possible, using the physicochemical composition of objects observed, to determine vegetation type and condition, water surface pollutant composition, to identify minerals, soils, to detect illicit drug-yielding crops and to determine many other physical parameters of the earth surface.

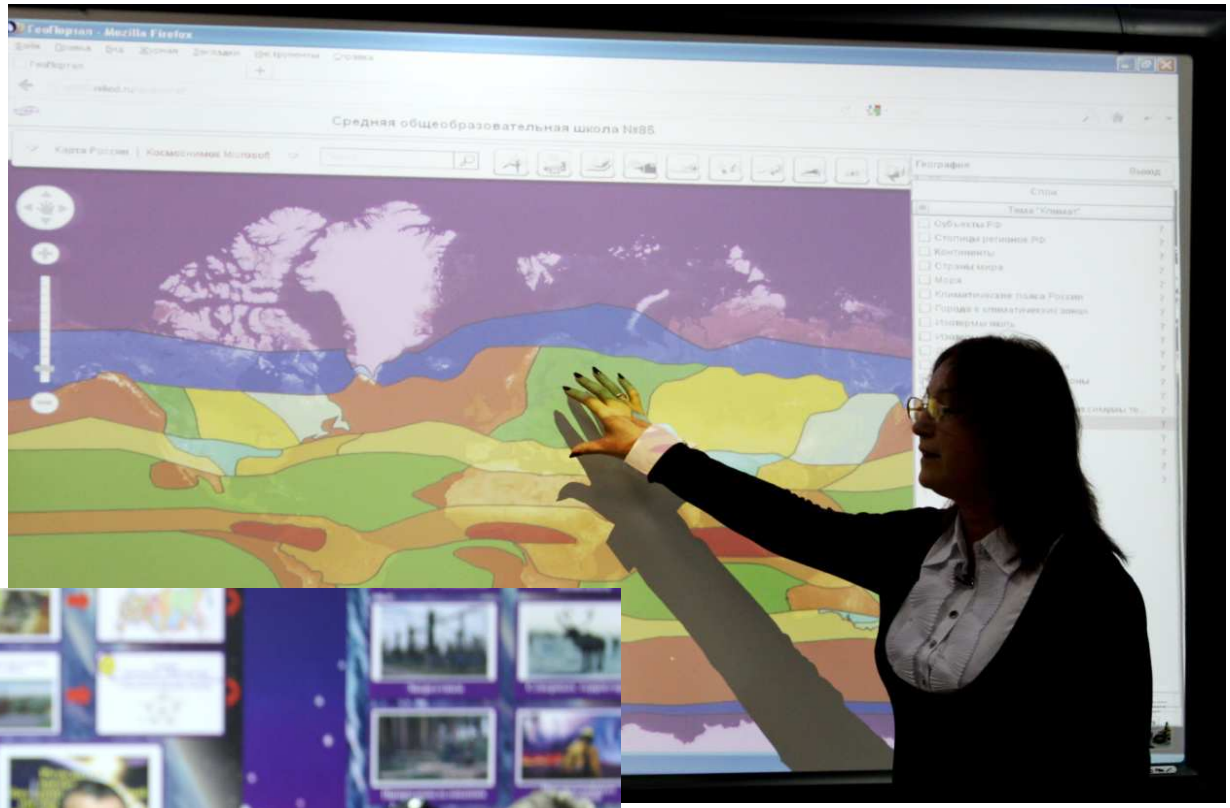
The main output product of the hyperspectral equipment data processing is reflectance values of homogenous surface.

Along with the generation of spectral images of the underlying surface objects the hyperspectral data enables the calculation of such indices as NDVI, EVI, ARVI and other characterizing vegetation cover state of health.

*Data used:
Resurs-P1 (30.08.2013)

SCHOOL CENTER OF SPACE SERVICES

OPEN LESSONS OF SPACE TECHNOLOGIES



THE STUDY OF GEOGRAPFY WITH THE USE OF REMOTE SENSING TECHNOLOGIES (THEME – THE EARTH”S CLIMATE)

Russian Federation
is open for collaboration
with the international community
in using and free distributing
of Russian remote sensing data

United nation, Vienna, 9-13 February 2015

ROSCOSMOS

Thank you for your attention!

Valery Zaichko

opoi@roscosmos.ru