

Russian Academy of Sciences
Space Research Institute



An overview of Russian Academy of Sciences' R&D activity on agricultural monitoring using EO data

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Monitoring, November 21, 2013, Brussels

Main component of R&D

- (I) Multi-annual of automatic near-real-time update EO data archive, including:
 - a. MODIS Surface Reflectance MOD09 from NASA (2000 - ongoing)
 - b. Landsat data download from USGS and ESA (1989-ongoing)
- (II) Automated EO data processing chains, including:
 - a. EO data pre-processing (cloud/shadow screening, image compositing, vegetation indexes generation, data time-series reconstruction and etc)
 - b. Thematic products generation (land cover/land use, active fires, burnt area and severity, crop masks and etc)
- (III) Web-based Users' Interface with data analysis tools
- (IV) Terrestrial (incl. agricultural) ecosystem change analysis

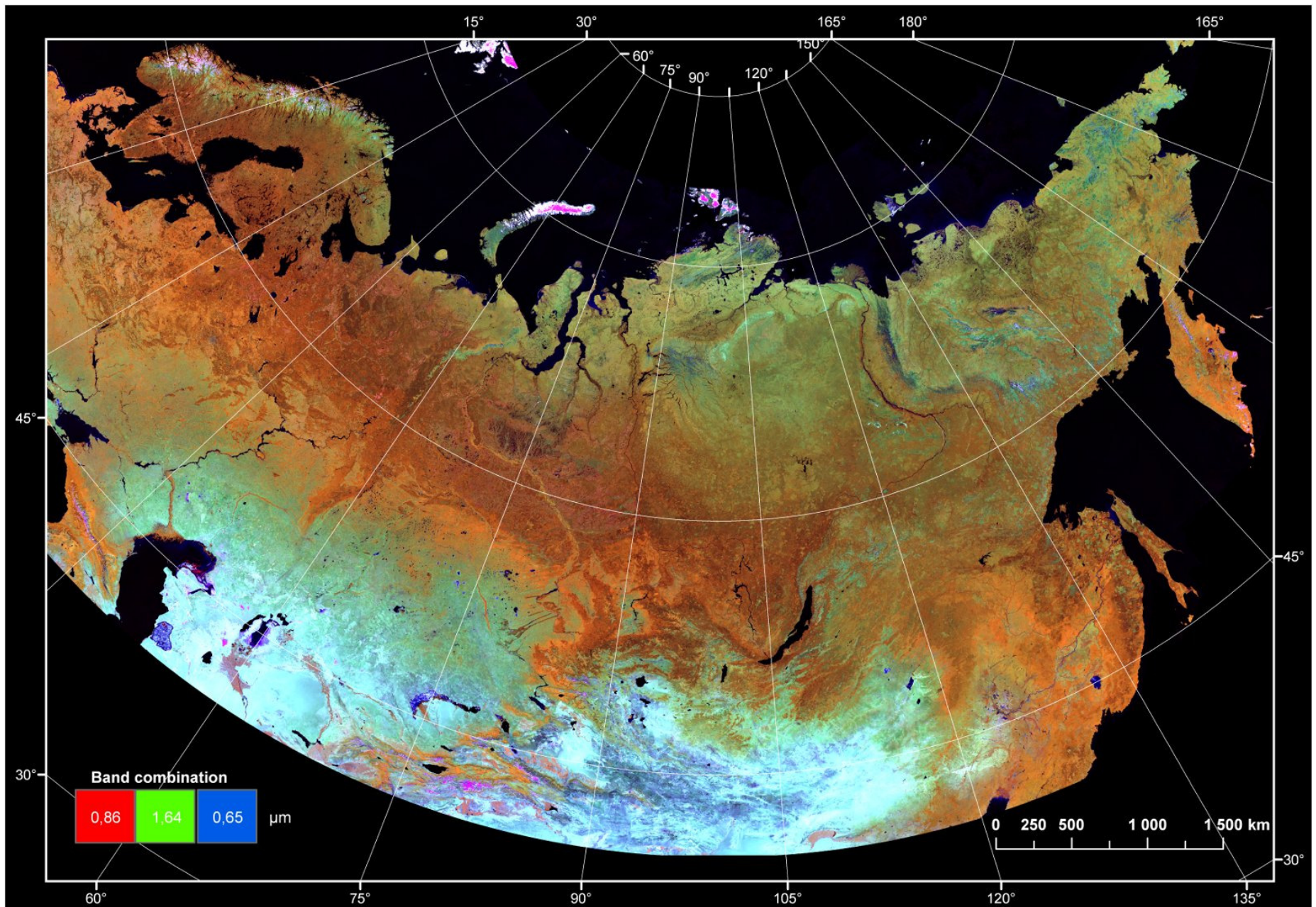
Main R&D thematic areas to agriculture monitoring

- (I) Land cover and land use mapping
- (II) Crop types mapping, including
 - Dynamic winter crops mapping
 - Fallow lands mapping
- (III) Crop status monitoring as an input to yield assessment, including
 - Winter kill
 - Summer drought

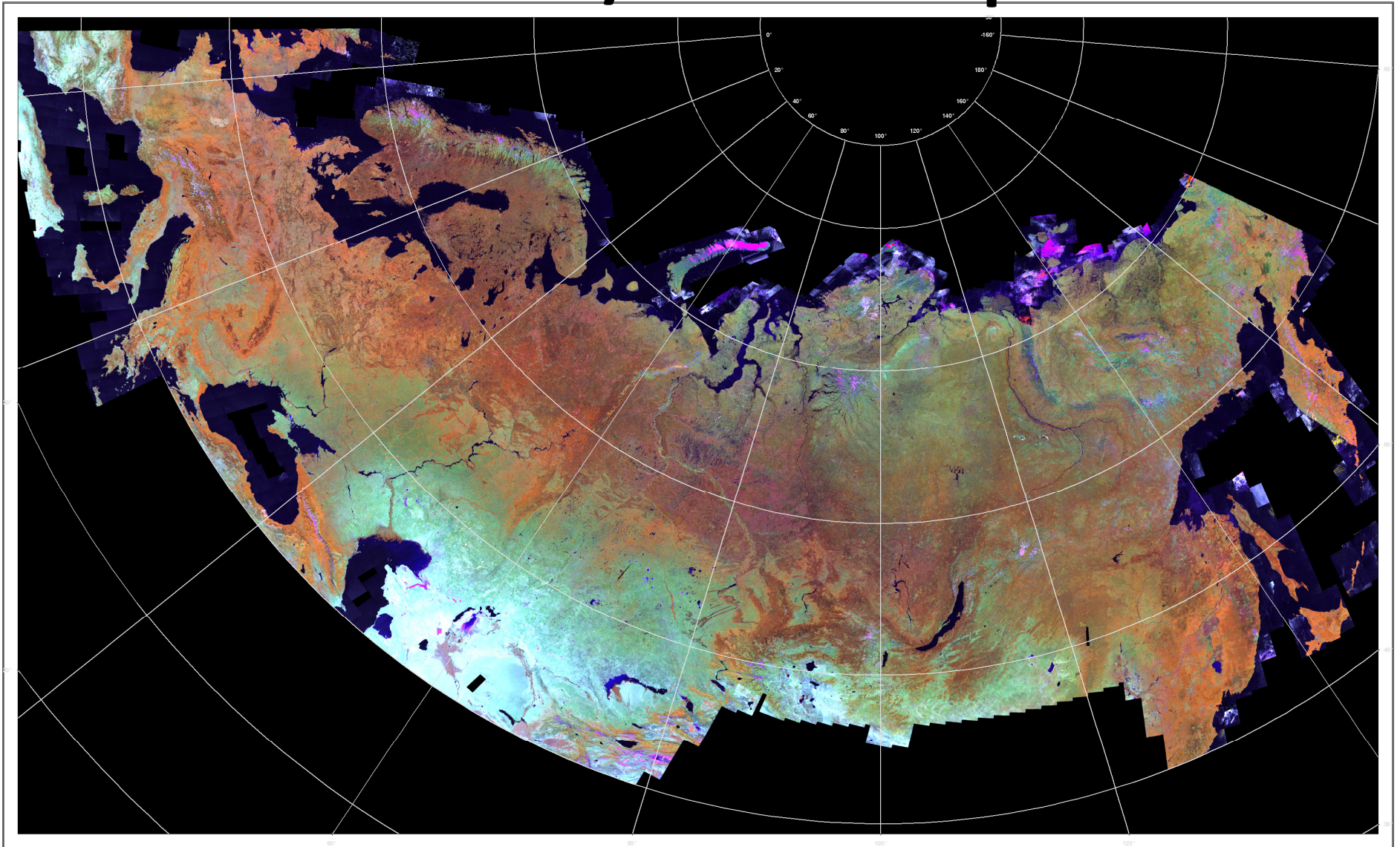
National context of R&D activity on agricultural monitoring

- Russian Statistical Agency (Agricultural Census of 2006 and preparation for the Agricultural Census of 2016)
- Hydro-meteorological Service (Crop yield forecast)
- Agro-insurance companies
- Regional governments (e.g. Krasnodar, Belgorod)
- Food-producing companies

Cloud-free summer MODIS composite

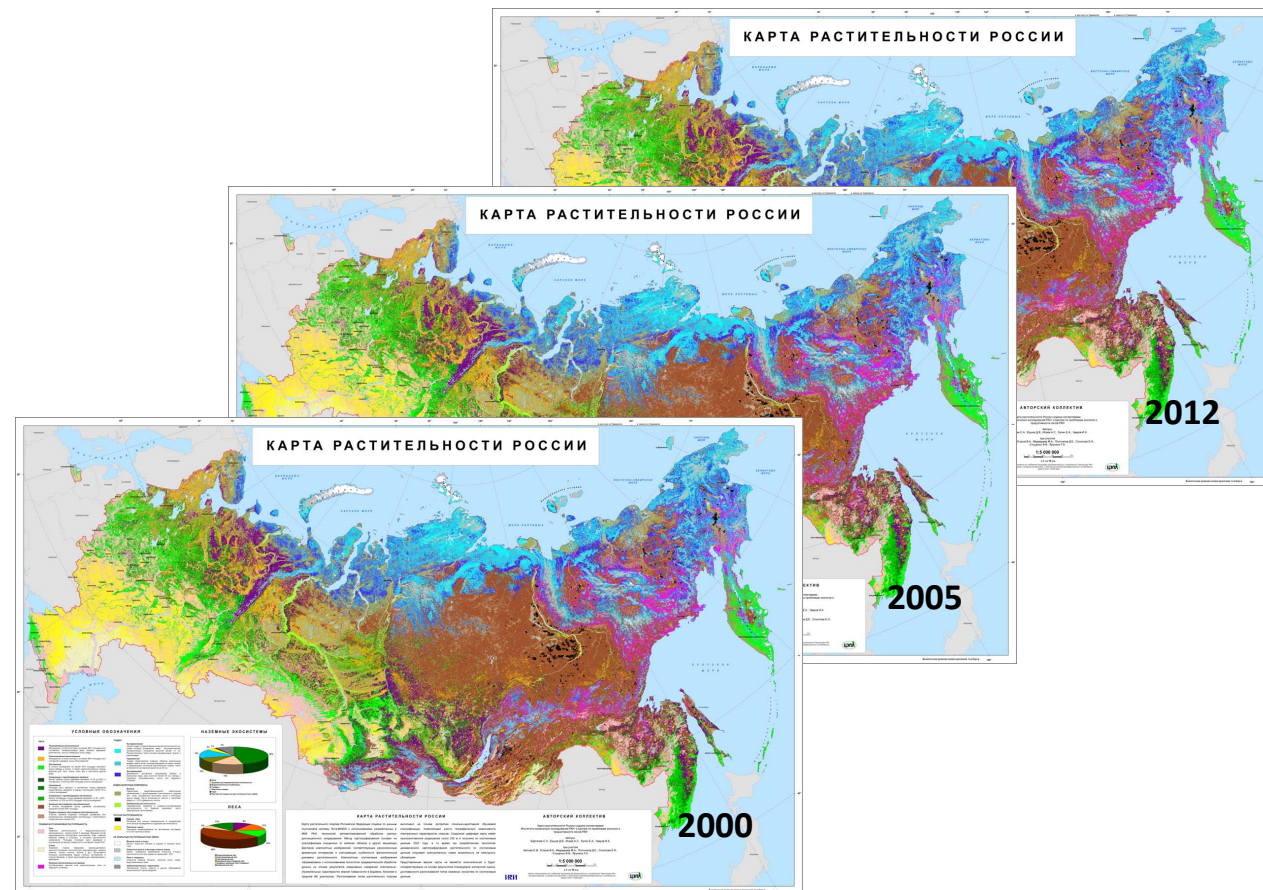


Landsat-TM/ETM+ composite



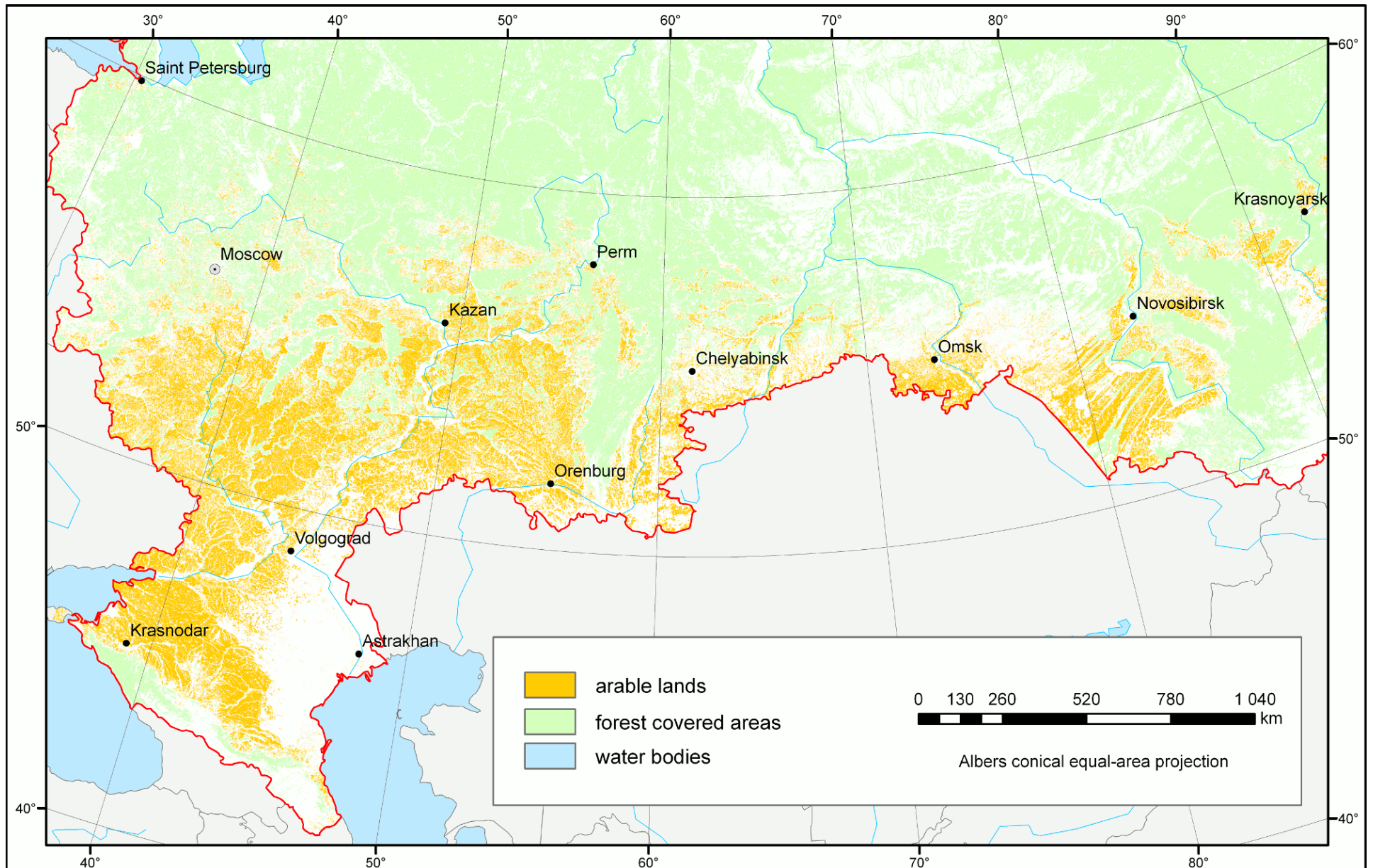
The automatic data processing chain allows yearly production of the Landsat-TM/ETM seasonal composites

Automated technology for annual land cover mapping based on MODIS data

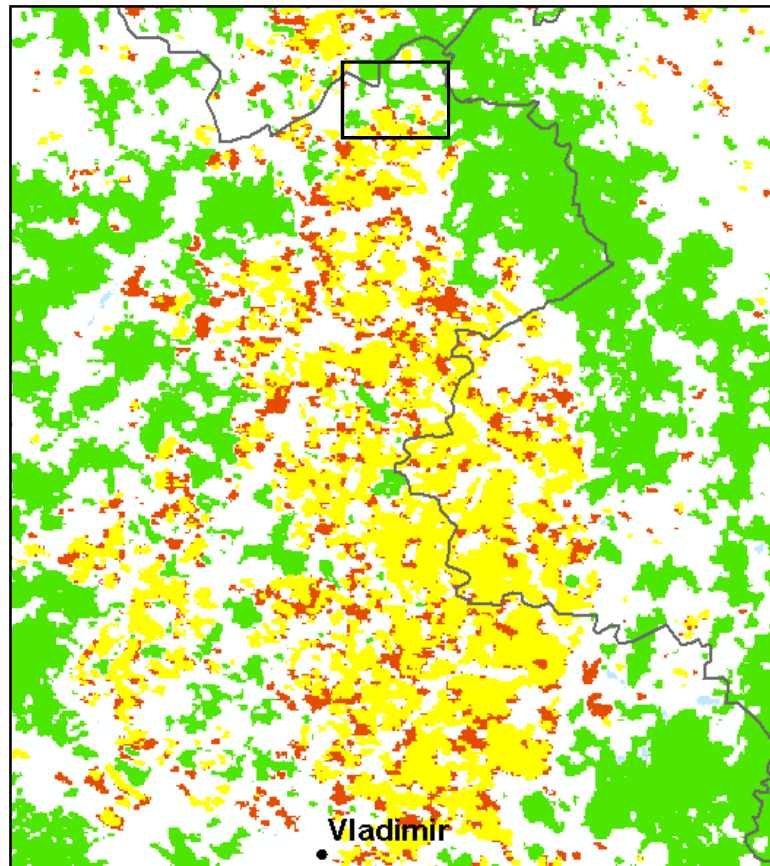


The homogenous time-series of land cover maps of Russia has been developed for the period of years 2000-2012.

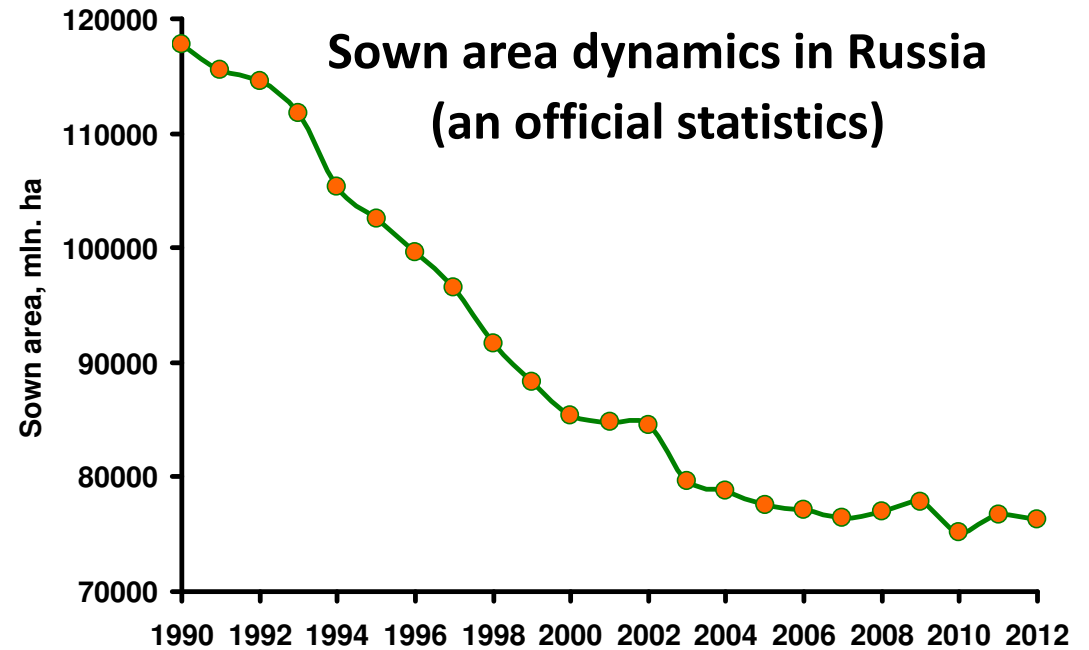
Annual mapping of arable lands using MODIS data time-series



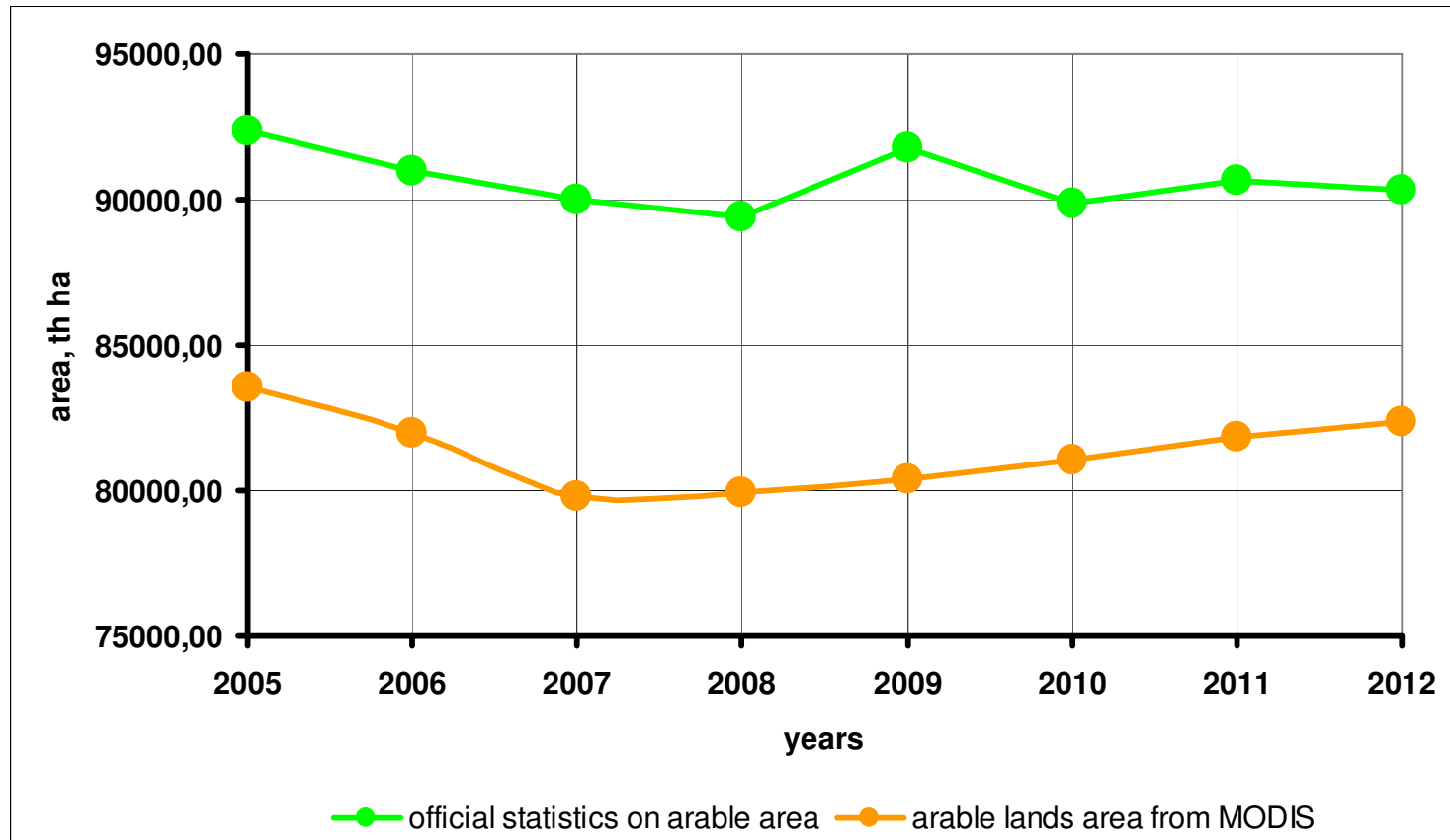
Abandoned arable lands mapping



-  Forest
-  Regularly used arable lands
-  Arable lands out of use > 5 years




Dynamic of arable lands in Russia



According to MODIS data time-series analysis the arable lands area in Russia is increasing since year 2007. The arable lands area grows during last 5 years at about $0,5 \text{ mln ha year}^{-1}$

Web-based Vegetation Monitoring Service VEGA: vega.smislab.ru



VEGA Service
satellite based service for vegetation analysis

About | Main | Pr

Username: Password:

Analysis of vegetation condition

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

Analysis of vegetation condition in the region

- [Information bulletins by region](#)

Fire situation

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

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

- [\[rus\] Status of winter crops - View from space, December 2011](#)
- [\[rus\] Status of spring crops in Russia, the situation in mid-August 2011](#)
- [\[rus\] The state of crops in Russia - the situation in mid-](#)

Welcome to VEGA-Service!

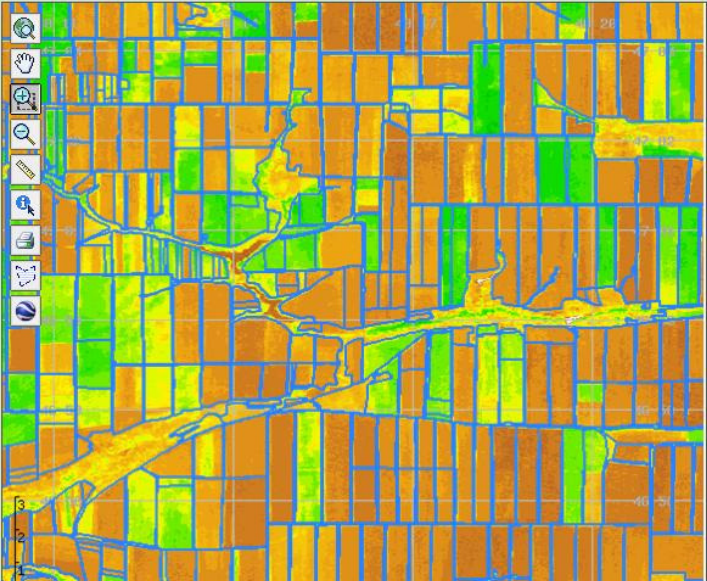
The web-service **VEGA** has developed by the Space Research Institute of Russian Academy of Sciences based mainly on integrated use of MODIS and Landsat-TM/ETM+ data and focused on wide range of vegetation monitoring applications with strong emphasis on forestry and agriculture.

The VEGA service data archive consists of MODIS surface reflectance products and Landsat-TM/ETM+ images over Russia and neighboring countries of the Northern Eurasian region for period starting from year 2000 with continuous daily update. The MODIS data pre-processing chain produces as an outcome time-series of weekly cloud-free data composites as well as spectral vegetation indexes of 250 m spatial resolution. The Landsat-TM/ETM+ imagery are also subject of routine pre-processing for radiometric calibration, as well as cloud and cloud-shadow screening. Being daily updated both these data sets are available for users through web interface together with thematic products and data analysis tools.

Available on the VEGA web-service MODIS data derived thematic maps have strong focus on vegetating cover status and dynamics and include such products as e.g. land/forest cover, active forest and non-forest fires, burnt area and severity, arable lands, crop types and some other maps. Depends on thematic products they are subject of daily, weekly or annual update in automatic or semiautomatic mode, which tougher with developed analysis tools gives an opportunity to evaluate land cover dynamics in various aspects.

The data analysis tolls available on the VEGA service allow extracting in on-the-fly manner multi-annual temporal profile of normalised-difference-vegetation-index NDVI for any area of interest indicated by user. The service provides rapid access to all available for certain area Landsat-TM/ETM+ imagery as well as tolls for land cover change visualisation using selected multi-temporal data. These and many other visualisation and measurement tools provide unique opportunity for integrated analysis of moderate- and high-resolution data highly exploiting their complementarities in terms of temporal frequency and spatial accuracy of different Earth observations instruments.

The VEGA service is foreseeing its growing geographical coverage and users' range at different levels, including federal and regional governments, forest management and logging companies, agro-holdings, insurance companies, credit organisations and others.





NDVI средний по району (земли занятые озимими)

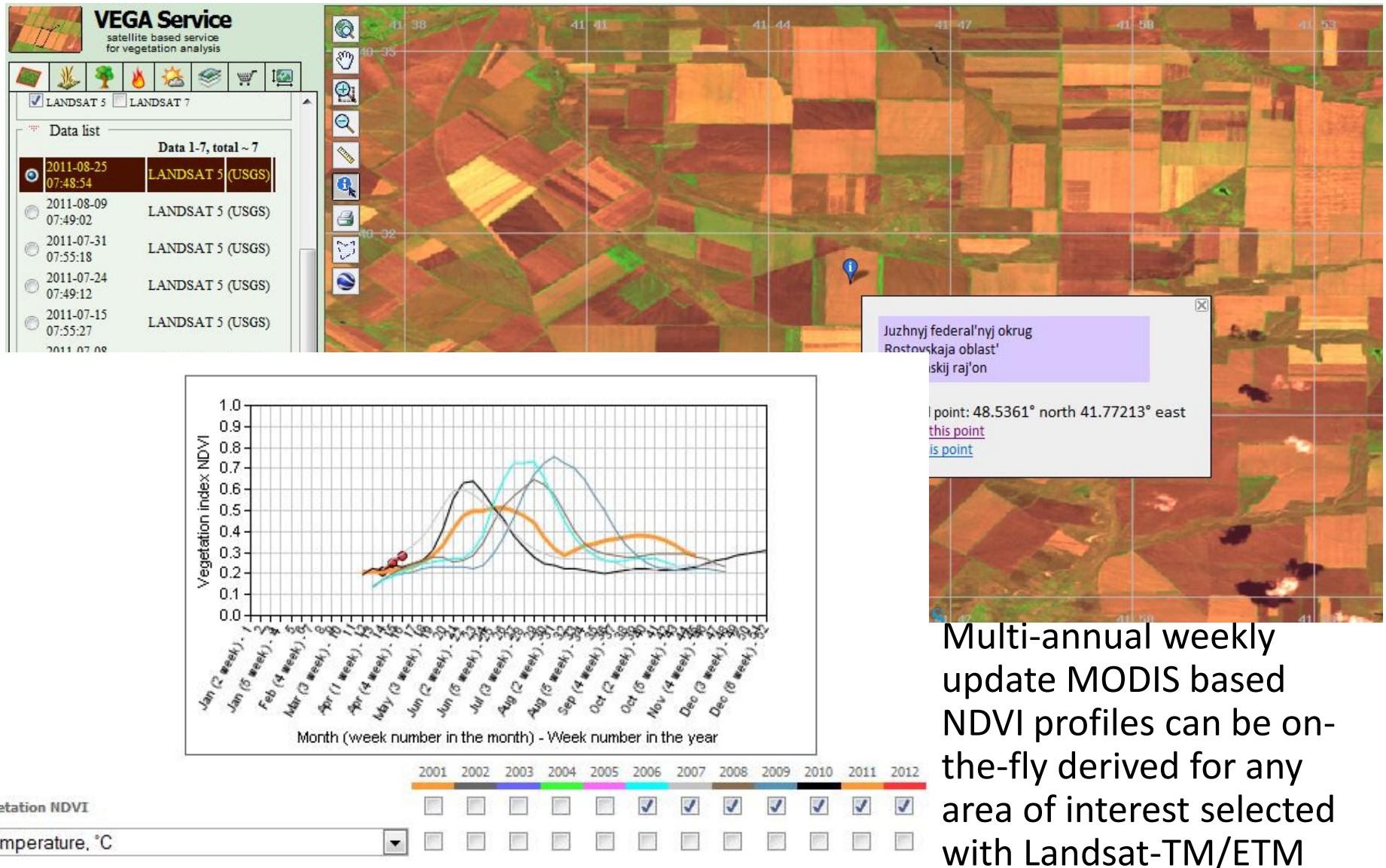
Vegetационный индекс NDVI

Температура, °C

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

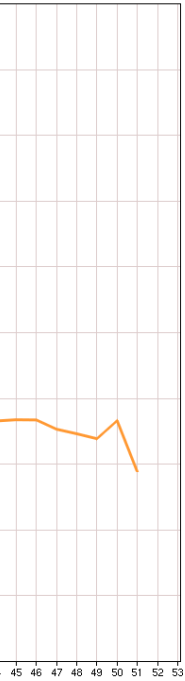
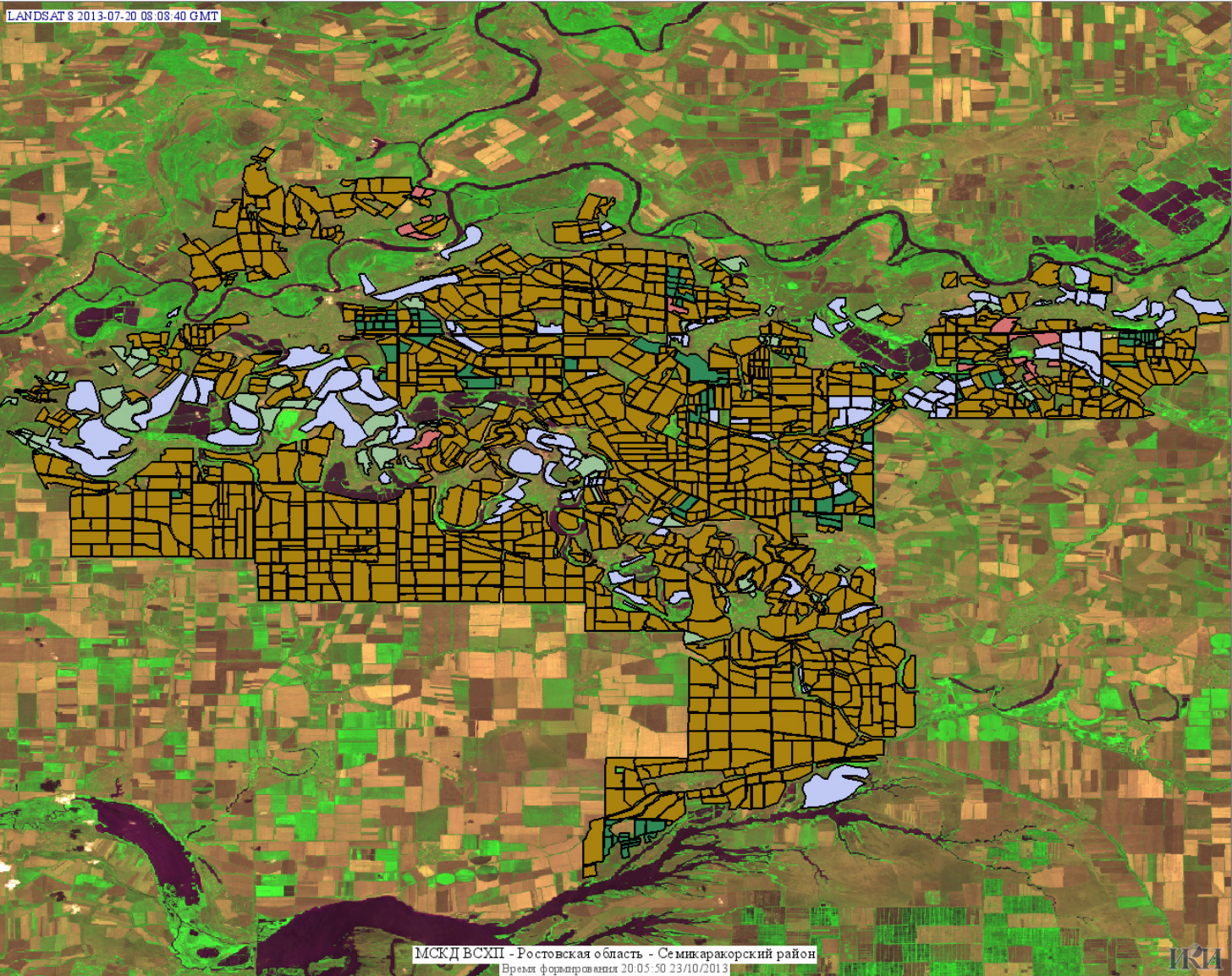
VEGA (in operation since May 2011) is developed by the Space Research Institute of the Russian Academy of Sciences to provide vegetation status analysis tools based on multi-annual and near-real-time EO data

MODIS and Landsat-TM/ETM+ data synergy in the VEGA Map Interface



Multi-annual weekly update MODIS based NDVI profiles can be on-the-fly derived for any area of interest selected with Landsat-TM/ETM

Land-use mapping using VEGA tools

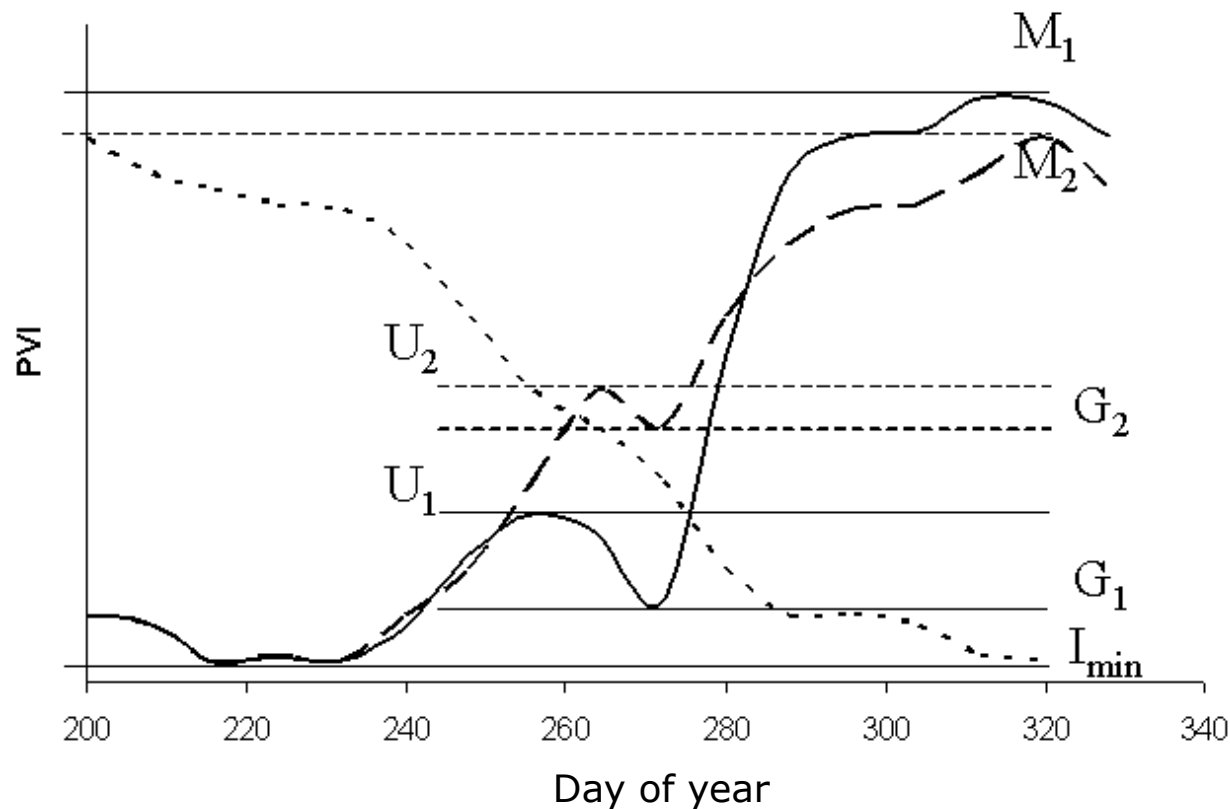


- Граница полей
- Залежные земли
- Сенокосы
- Обрабатываемые пахотные земли
- Многолетние насаждения
- Пастбища

МСКД ВСХП - Ростовская область - Семикаракорский район
 Время формирования 20.05:30 23/10/2013



Winter crop recognition based on MODIS

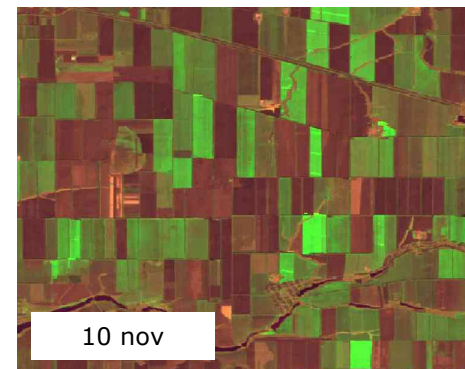
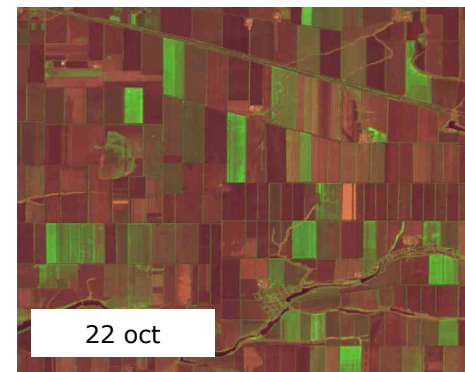
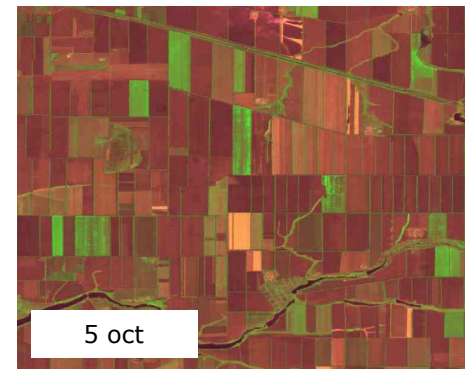


«Continuous growth» means meeting 2 conditions:

1. $PVI(t) > PVI(t_0), t > t_0$
2. $(U_k - G_k) < (G_k - I_{\min})$

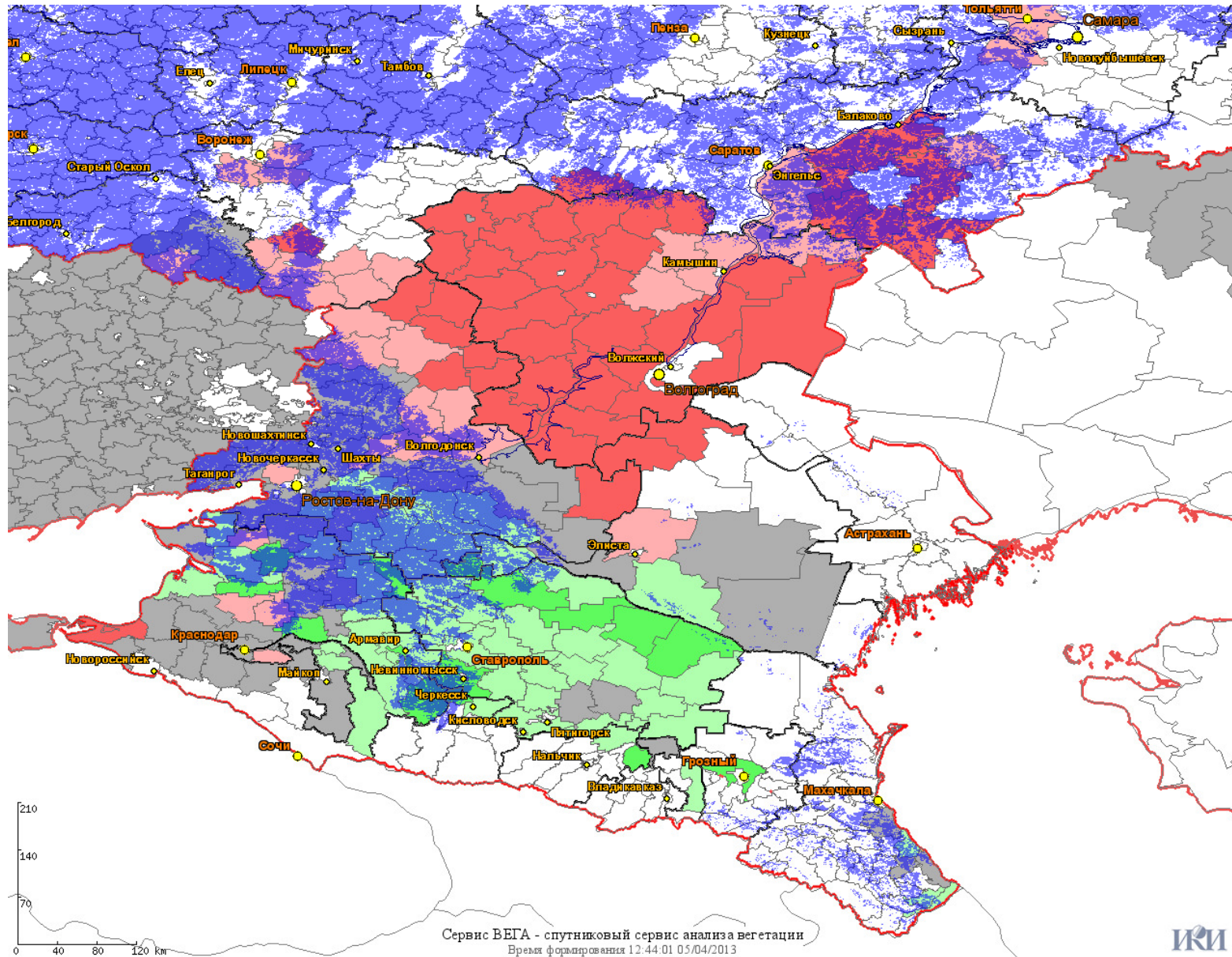
Decision rule:

«Continuous growth» duration > 15 days

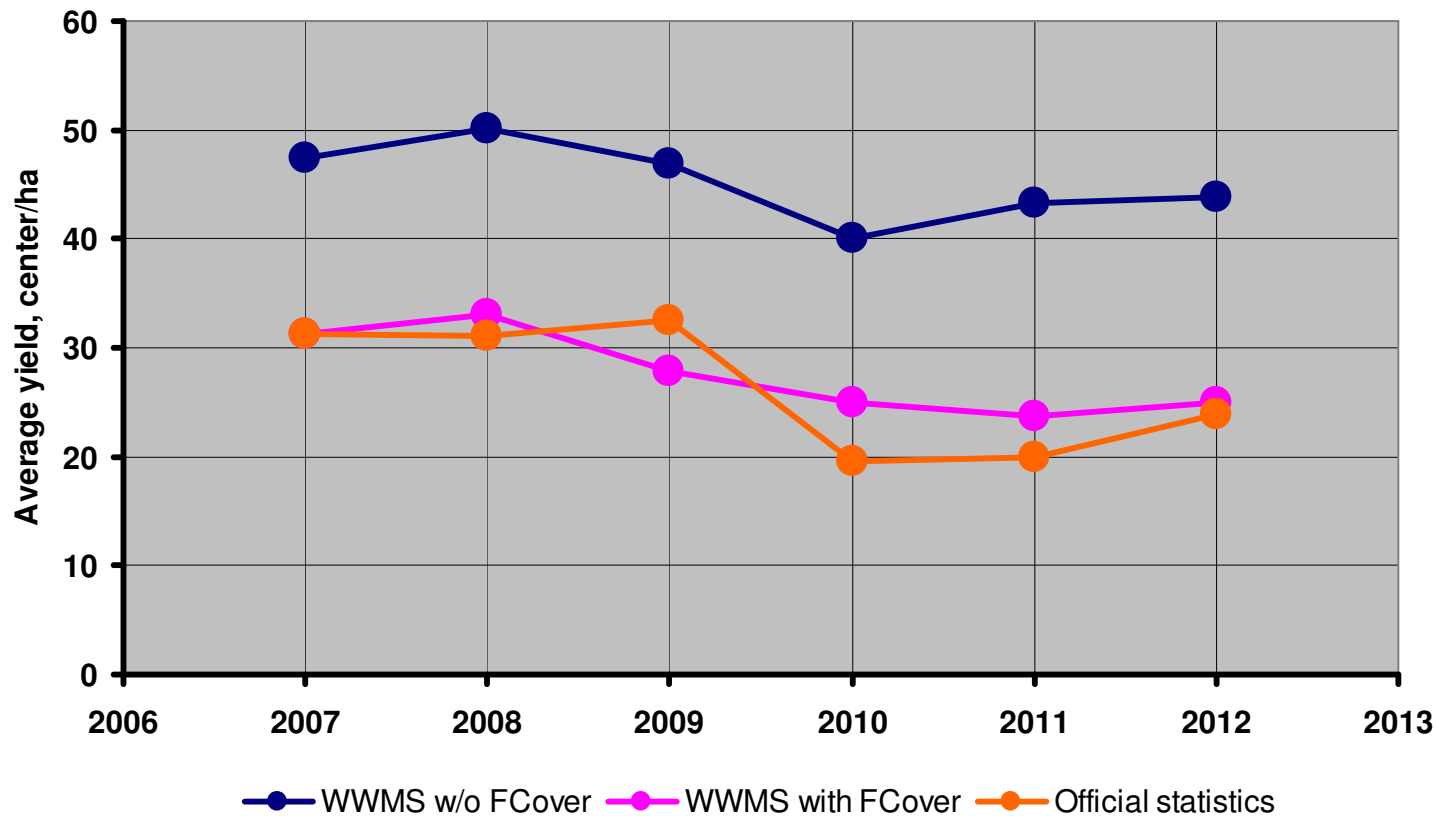


Green up

Winter crop status assessment

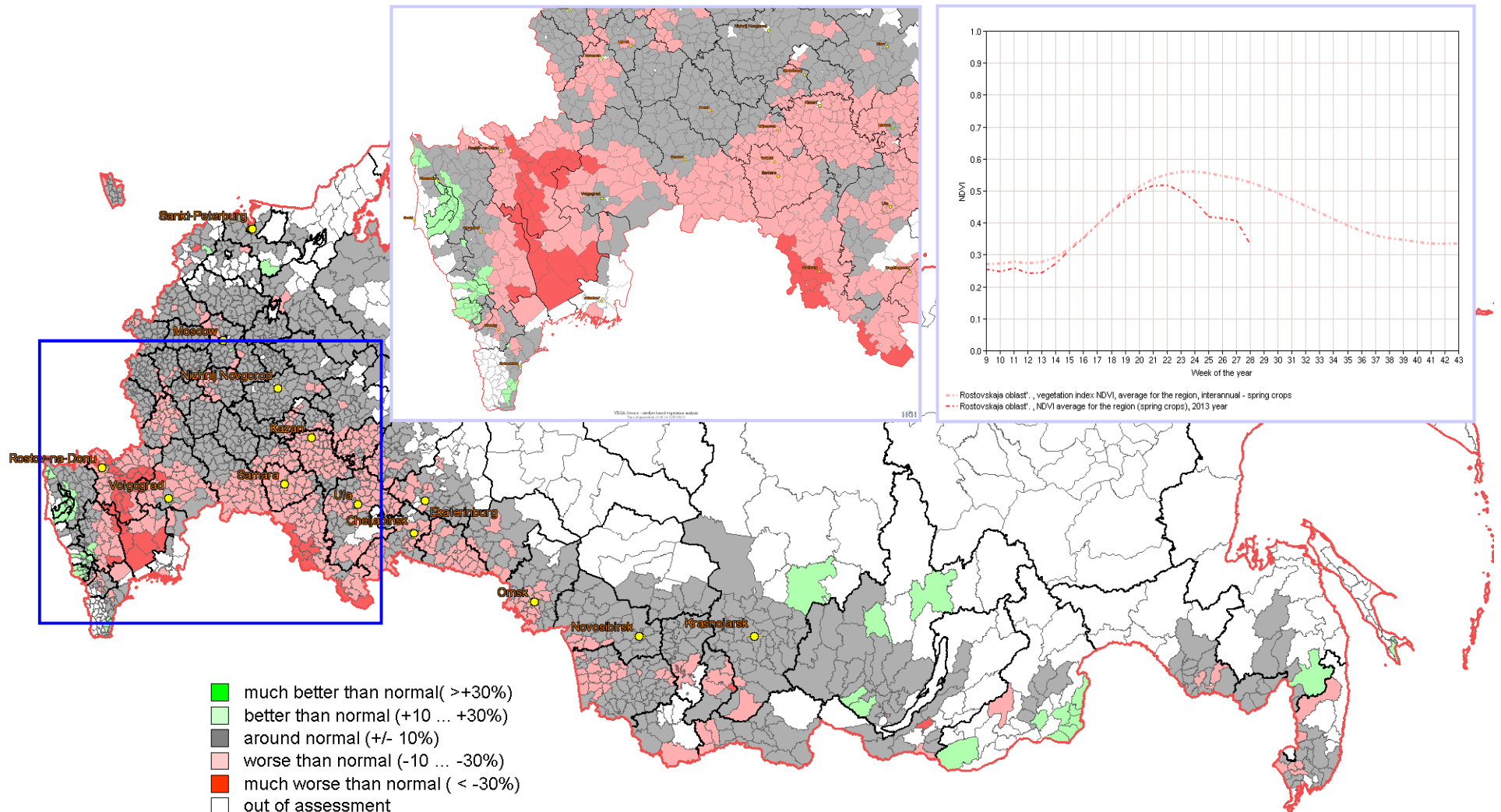


Winter crop yield prediction with WOFOST model and RS data assimilation



The MODIS derived multi-annual Fcover estimates of winter crops in Tula region have been assimilated into WOFOST model in comparison to original model and official statistics (the result of FP7 MOCCASIN project).

Spring crops of year 2013 NDVI seasonal profile departure from multi-annual mean



The NDVI seasonal profile departure from multi-annual mean has demonstrated anomalies which are caused by drought in several regions of European part of Russia, such as Rostov, Samara, Tatarstan and Bashkortostan.

R&D Priorities

- (I) Integration of new EO data:
 - a. Moderate resolution data (Sentinel-3, Proba-V, NPP)
 - b. High resolution data (Sentinel-2, Kanopus-V)
- (II) Development of new thematic products:
 - a. Land-use
 - b. Crop types
 - c. Crop yield
 - d. Bio-physical characteristics (Fcover, LAI)
- (III) Crop growth modelling with assimilation RS data derived products

R&D Collaboration Framework: Addressing Community Capacity

- (I) VEGA-Science as a common technical platform for R&D on agricultural monitoring in Northern Eurasia
 - a. Facilitated access to open EO long-term data archives
 - b. Thematic products cross-comparison and validation
 - c. Models benchmarking

- (II) JECAM test-sites network development in Northern Eurasia region, considering R&D coordination with:
 - a. EO data providers for ad-hoc data acquisition
 - b. Regional agricultural research institutions
 - c. National agro-meteorological networks



Regional workshop

"Satellite Monitoring of Agricultural Lands in Northern Eurasia"

October 28-31, 2013, Moscow, Russia



geoglam.smislab.ru