VEGA-GEOGLAM
Global agricultural monitoring service

User Guide

Version 1, 06/2017
Space Research Institute of Russian Academy of Sciences

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I. About VEGA-GEOGLAM

VEGA-GEOGLAM (vega.geoglam.ru) is a global agricultural monitoring service aimed to perform cropland mapping and assessment using Earth Observation (EO) and in-situ data analysis. The system developed by Space Research Institute (IKI) of Russian Academy of Sciences in the framework of European Commission's FP7 SIGMA project.

The VEGA-GEOGLAM objectives are:

- To provide users with EO data and their analysis tools for on-line cropland monitoring at multiple spatial levels;
- To combine EO and in-situ data analysis over the SIGMA-JECAM test sites;
- To serve as a platform for R&D activity focused on remote sensing method
- To serve as e-learning platform in the field of remote sensing and GIS applications for agricultural monitoring.

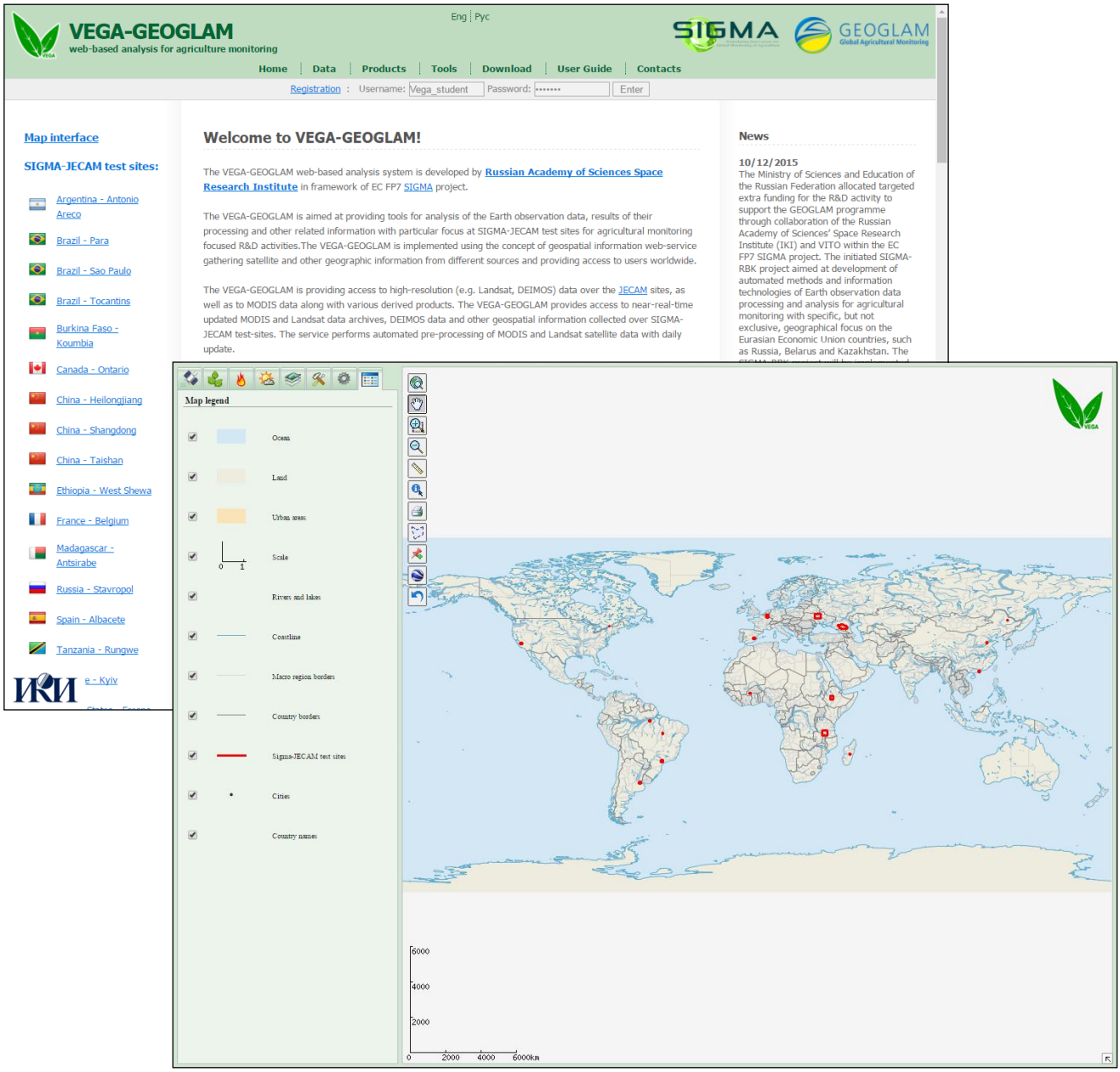


Figure 1: Main page and Map Interface of the VEGA-GEOGLAM portal. SIGMA/JECAM test-sites are delineated in red.

As a geographical data analysis web-service, VEGA-GEOGLAM covers a broad variety of agricultural monitoring applications focused at different types of users and levels - from a field to regions and countries. VEGA-GEOGLAM users are scientists, students, public officials, agricultural producers and insurance companies. List of potential VEGA-GEOGLAM applications presented in table 1.

A user can upload to VEGA-GEOGLAM data on field borders (and other attributive information) and monitor the crop conditions detecting anomalies and trends in crop development. A user can work with more than 1,5 Pb of pre-processed EO data and derived products, such as:

- Satellite Imagery and cloud-free image composites;
- Thematic maps;
- NDVI time series data;
- Meteorological data;
- Field data;
- Fires on agricultural and non-agricultural lands.

VEGA-GEOGLAM benefits:

- **All-in-one** - there are two core components in VEGA-GEOGLAM: Data and Data Analysis Tools. VEGA-GEOGLAM gathers satellite and other geographic information from different sources and provides access to it along with tools for integrated on-line data analysis via the web-interface. VEGA-GEOGLAM aggregates data from different satellite instruments in the one interface;

- **On-line** - to work with the EO data archive and GIS tools a user is not required to download any software or to deploy a network: all a user need is Internet and registration in the system;

- **Time series and trends -** an access to the multi-year time series of EO data and automatically calculated multiannual NDVI norm (mean) providing an opportunity to assess crop development at local (field) and regional levels;

- **Ongoing updating** – daily update of EO data archives with newly acquired data;

- **Scalability -** VEGA-GEOGLAM is a continuously developing system. The modular architecture of the system allows fitting into new requirements and projects.

Applications

VEGA-GEOGLAM is designed to cover different agricultural monitoring applications based on EO data as presented in the Table 1.

Table 1. VEGA-GEOGLAM applications

Application	System capacities
Cropland monitoring	• Up-to-date EO data viewing and downloading (data from more than 15 satellites instruments are available); • Creating of EO data time series for user defined area of interest; • Land usage and crop development monitoring with visual image interpretation tools
Crop status assessment	• Using of weekly updated metrics (mean NDVI for a field, NDVI loss/gain and etc) for crop status assessment; • Current NDVI value to norm value comparison and anomalies detection in crop development (norm is often defined as multiyear mean); • Field vegetation development trend comparison; • Field heterogeneity assessment;
Field usage history analysis	• Field usage history analysis for any period of time from year 2000; • Field usage control through a season; • Agricultural management practice assessment
Land cover and land use mapping	• Field borders delineation; • Land cover mapping; • Cropland and other agricultural land mapping: arable/non-arable lands, winter /spring crops, crop types.
Conditions assessment, adverse factors identification	• Meteorological condition assessment and forecasting; • Agricultural management planning; • Agricultural fires detection and impact assessment.
Yield estimation	• Crop development condition on a field comparison with other fields and with previous years; • Crop development trend analysis; • Yield predictors estimation.
Validation of the remote sensing methods over the SIGMA-JECAM test sites network	• In-situ data analysis; • Joint experiments using VEGA-GEOGLAM data and tools; • New EO data processing methods testing.
EO data dissemination	• EO data export to other systems via API;
GIS / EO data users trainings	• VEGA-GEOGLAM use as an educational platform

Basic Requirements

The service is freeware, but registration is needed. Basic requirements to use VEGA portal are:

- Internet connection >10 Mbps;
- Google Chrome or Mozilla Firefox browser (with cookies allowed);
- VEGA-GEOGLAM account.

Contacts

If you have any questions about VEGA-GEOGLAM or you have noticed a bug, please email us at **vega@smis.iki.rssi.ru**

Our team: http://smislab.ru/default.aspx?page=39

Links:

VEGA-GEOGLAM service
http://vega.geoglam.ru

Space Research Institute of Russian Academy of Sciences
www.iki.rssi.ru/eng

Stimulating Innovation for Global Monitoring of Agriculture
http://www.geoglam-sigma.info

Group on Earth Observations Global Agricultural Monitoring Initiative
http://www.webmodele.com/index.php/en/.

II. Getting started

Home Page

To start work with the service:

→ Go to vega.geoglam.ru

The VEGA-GEOGLAM home page (start page) opens (fig.2). There are five main sections at the Home Page:

1 - Registration link – click here to register. The Registration Page opens in new window;
2 - Login section - enter your Login/Password;
3 - Map interface - click here after logging in to open the system interface;
4 - As an option select any SIGMA-JECAM test site and you will be navigated to the specified region (Map interface opens);
5 - News feed – read about recent VEGA-GEOGLAM updates and events;
6 - Bug report – scroll down Home Page to see the Bug report link. This option allows sending a letter with a description of any bug or problem to the VEGA-GEOGLAM Administrator.

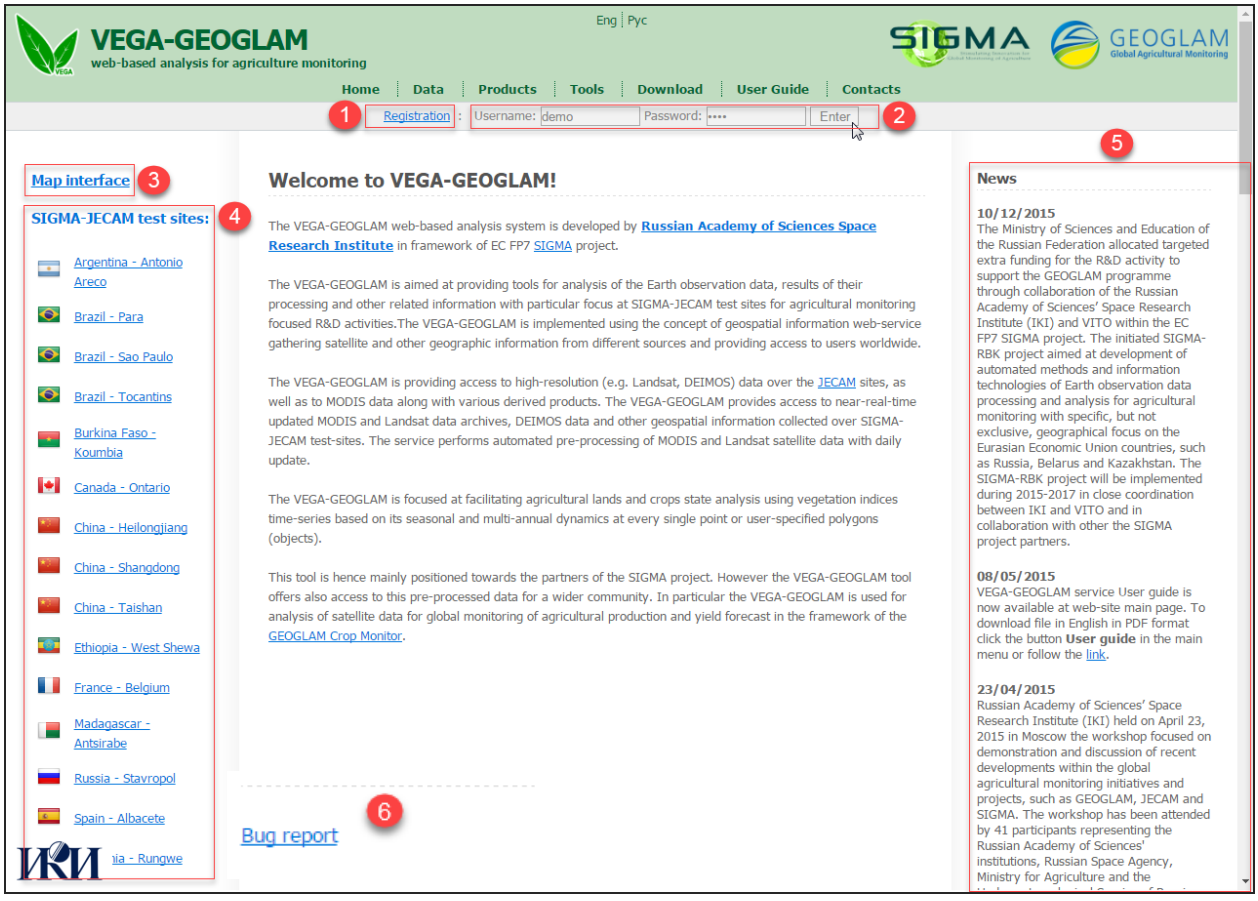


Figure 2: VEGA-GEOGLAM Home Page.

Registration

To register:

→ Go to vega.geoglam.ru/registration.shtml;
→ Read the User Agreement;
→ Fill the **Registration Form** (fig.3, 1-10);
→ You will receive a confirmation e-mail.

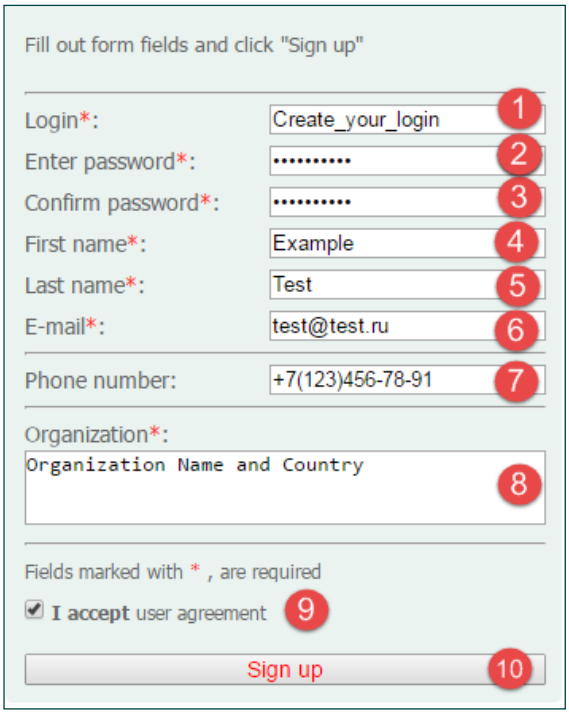


Figure 3: Registration Form

User groups

Users can belong to one group, which means that all users from this group can see the common user defined objects (fields) and data in the Map Interface.
If you need to unit several users into one group or you need to assign different permissions to users from one group, please e-mail the system administrator at **vega@smis.iki.rssi.ru**.

Demo access

To evaluate the capabilities of VEGA-GEOGLAM try it without registration: use the demo/demo login and password. DEMO login parameters stay as a default on vega.geoglam.ru (fig.1 (2)).
DEMO users have some restrictions, such as not be able to view high-resolution EO data for the last month and not be able to set (to draw) a field and view it's NDVI time series.

You can work with the demo fields (fig.4):

→ Go to **Agricultural data** tab and turn on **Fields contour** checkbox;
→ Navigate to 50.72 Lat 36.09 Lon (Belgorod Oblast (Region).

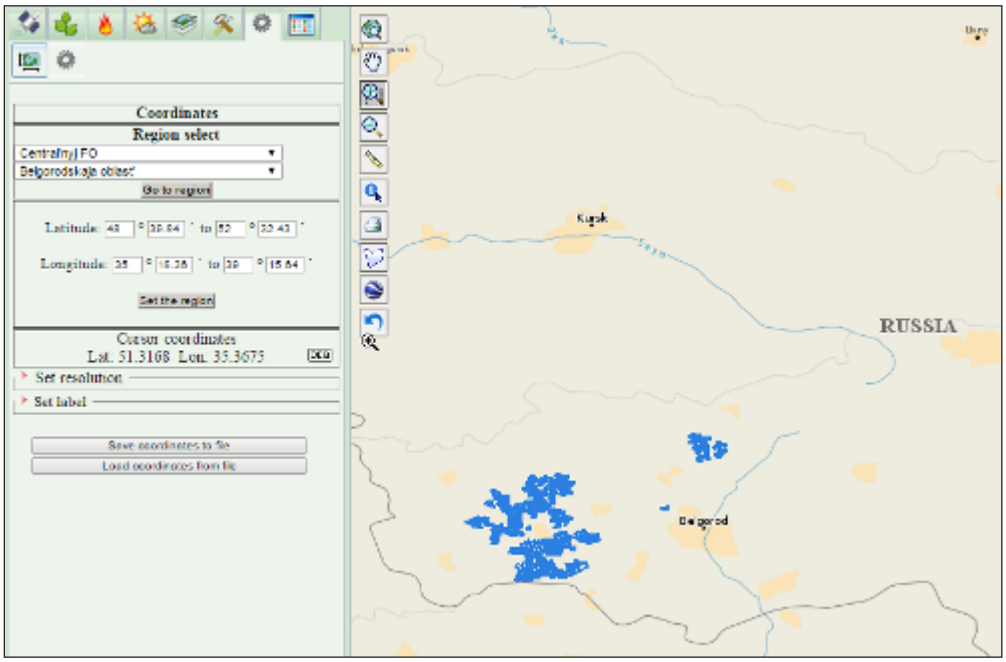


Figure 4: DEMO fields (group of fields that are available for demo access).

Interface

After logging in, click the **Map interface** link on the main page (fig. 2(3)). Map Interface opens in new browser window (fig. 5).

VEGA-GEOGLAM Interface includes the following elements:

1. Map Window
2. Toolbar
3. Groups of Tabs
4. Tabs
5. Tab content
6. Scale
7. Minimap

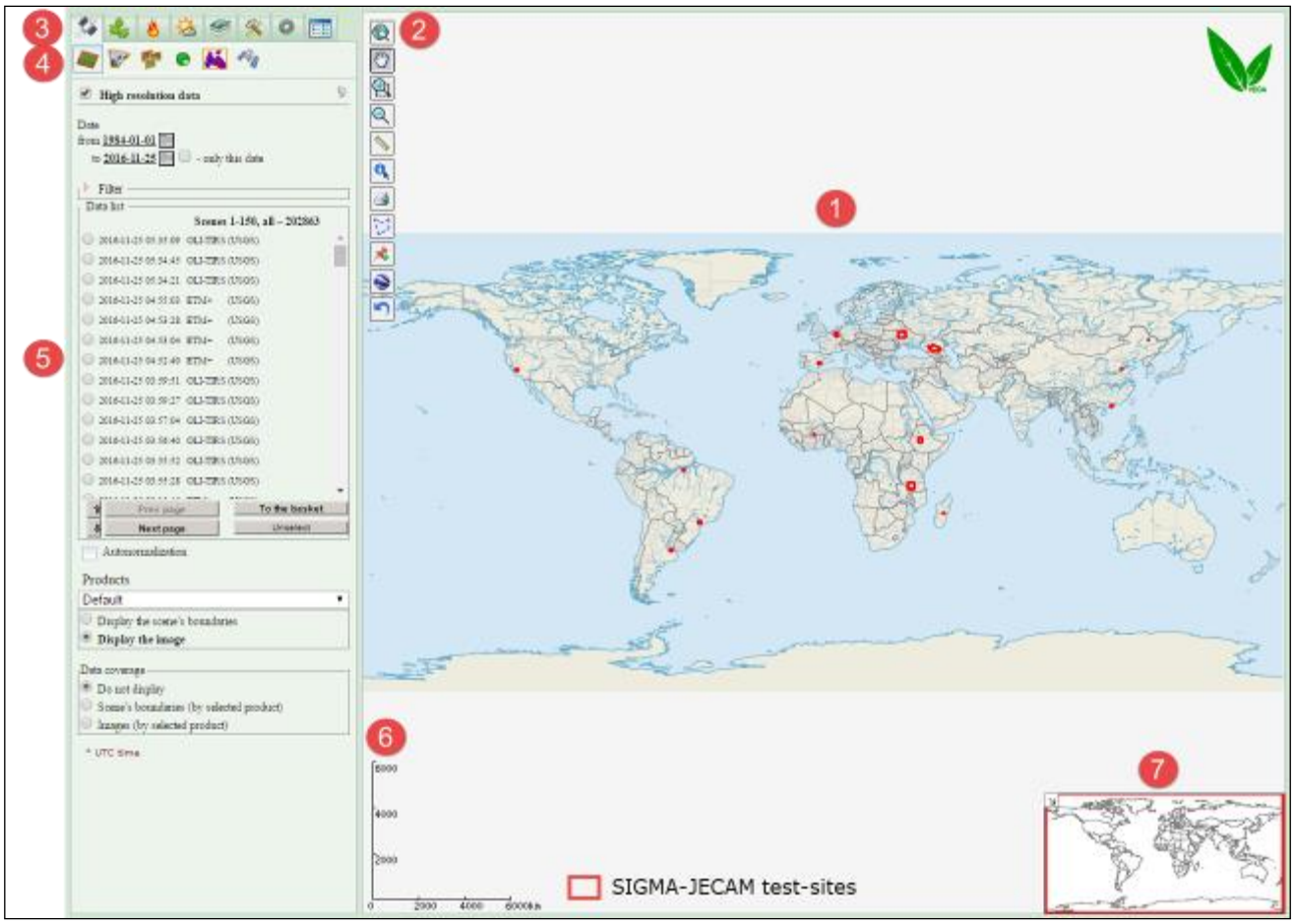


Figure 5: VEGA-GEOGLAM Map Interface.

Toolbar

Toolbar contains action tools (fig.6):

Full extent

Pan (Screen moving)

Zoom

Zoom out

Length (distance measurement)

Query (get info about an object)

Print (save an active screen as image)

Polygon (field drawing)

Add Point Object (add a point to a group of points)

View in Google Earth (all layers save in .kml file)

Back (return to the previous extent)

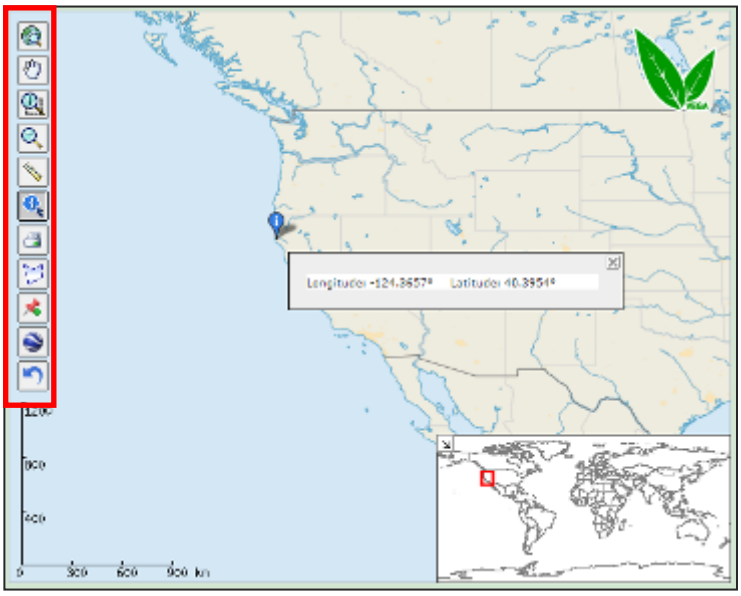


Figure 6: VEGA-GEOGLAM Toolbar.
Query tool shows coordinates of the selected point.

Groups of Tabs

A user works with data and tools in VEGA-GEOGLAM through the Groups of Tabs. Each Group of Tabs contains thematic Tabs with various tools.

Figure 7: VEGA-GEOGLAM Group of tabs.

For detailed information about each Group of tab see the table 2.

! Tabs may overlay each other.
If you cannot see some data (layer) on the map, try to turn off uncheck some tabs (to make it inactive).

Table 2. Groups of Tabs description

Group of Tab	Description	Tabs
EO data	Find and select satellite images	• High resolution data • Moderate resolution data • Composite images • Radar data • My products • Public products • ISS (International Space Station) data
Agricultural data	Work with fields and agricultural maps on local and regional levels	• Field vegetation status analysis • Vegetation statuse analysis at districts level • Agricultural maps
Fire data	Fire location by date	Group has no tabs
Meteorological data	Actual and historical weather data	Group has no tabs
Base Maps	Basic maps (county borders and thematic maps)	• Base maps • Land cover maps
Data Analysis	EO data processing and analysis tools	• Basket • Image color enhancement • Point objects • Classification • User maps • Image algebra • Indices calculation • Band selection • Irregularity of vegetation • Palette
Navigation and Reprojection	Change projection and setting the coordinates of the area of interest	• Coordinates • Interface parameters
Map Legend	Layer management	Group has no tabs

Setting up displaying options

Almost all operations in VEGA-GEOGLAM start with navigation to the area of interest (AOI) and setting up the displaying options. Before starting to work with satellite data in VEGA-GEOGLAM, a user can customize the interface by enabling or disabling base layers, enabling or disabling Grid or Scale, by changing a projection of a map.
There are two Groups of Tabs to manage visible map layers: Base Maps and Map Legend.
Base Maps Tab allows you to turn on/off base maps. Map Legend Tab allows you to view all active layers.

Base Maps

→ **Go to Base Maps** → **Base Maps** 

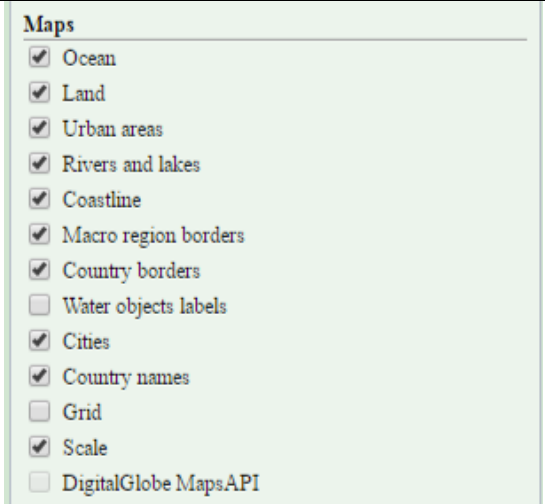
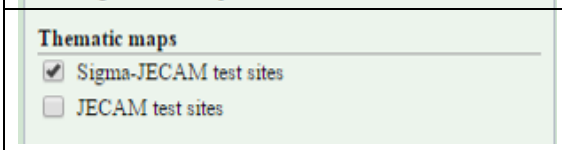
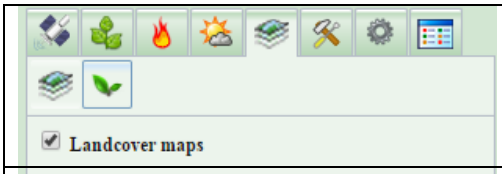
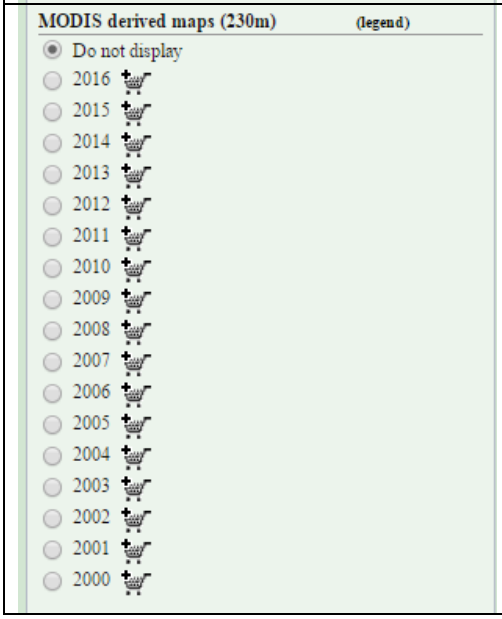
	Turn on/off the Base Map tab (displaying on the map)
	List of the maps (layers). Country borders and a layer are displayed by default. The source of the most of the layers is Open Street Map (www.openstreetmap.org); Digital Globe Maps are mosaic of high-resolution satellite imagery provided by Digital Globe. Digital Globe Maps work only with Mercator projection.
	Thematic maps are represented by SIGMA-JECAM and JECAM test sites borders. They are marked in red squares on the map.

Figure 8: Digital Globe map

Land cover Maps

Land cover maps are categorical-type thematic maps derived from remote sensing images.

→ **Go to Base Maps** → **Landcover Maps**

	Turn on/off the Land cover Maps tab
	MODIS derived annual land cover maps The land cover map was produced using time series of MODIS images and updates every year. Spatial resolution is 230 meters. Click **legend** to open the map legend. A user may add the map to the basket to use it as training set for image supervised classification.

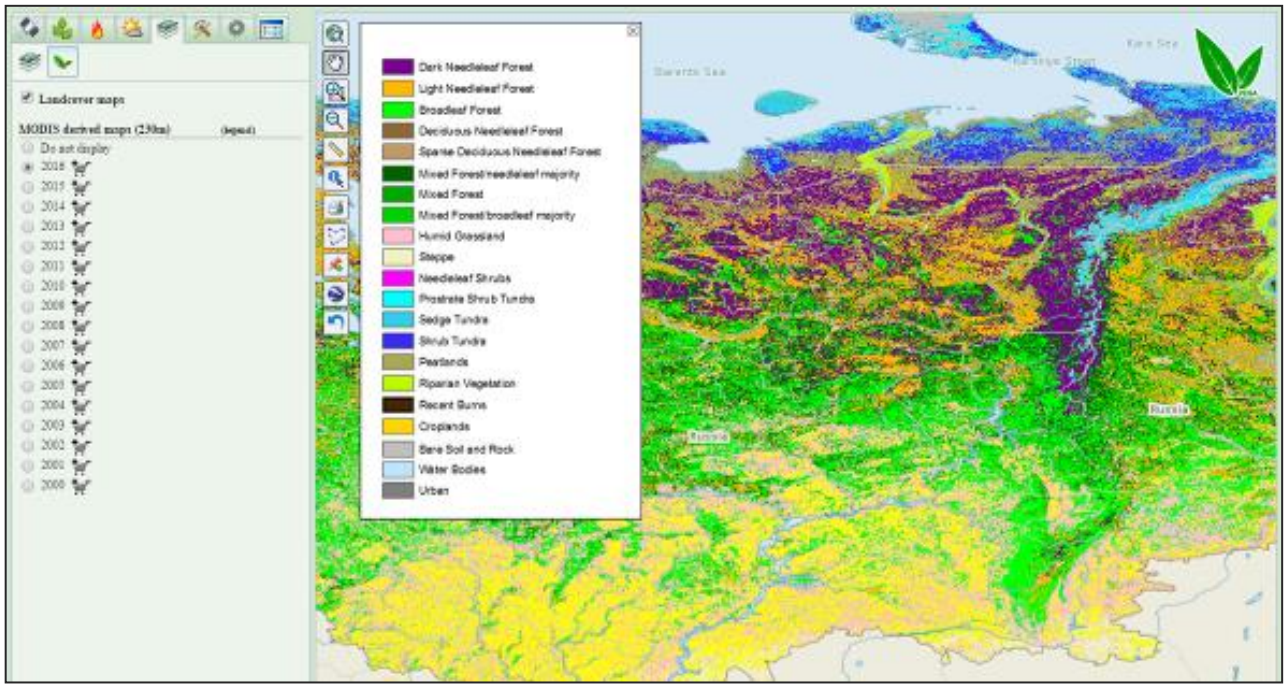


Figure 9: Land cover Map 2016. Southern Russia is agricultural belt of the country (in yellow).

Map legend

Map Legend Tab allows to view all active layers from all the tabs.

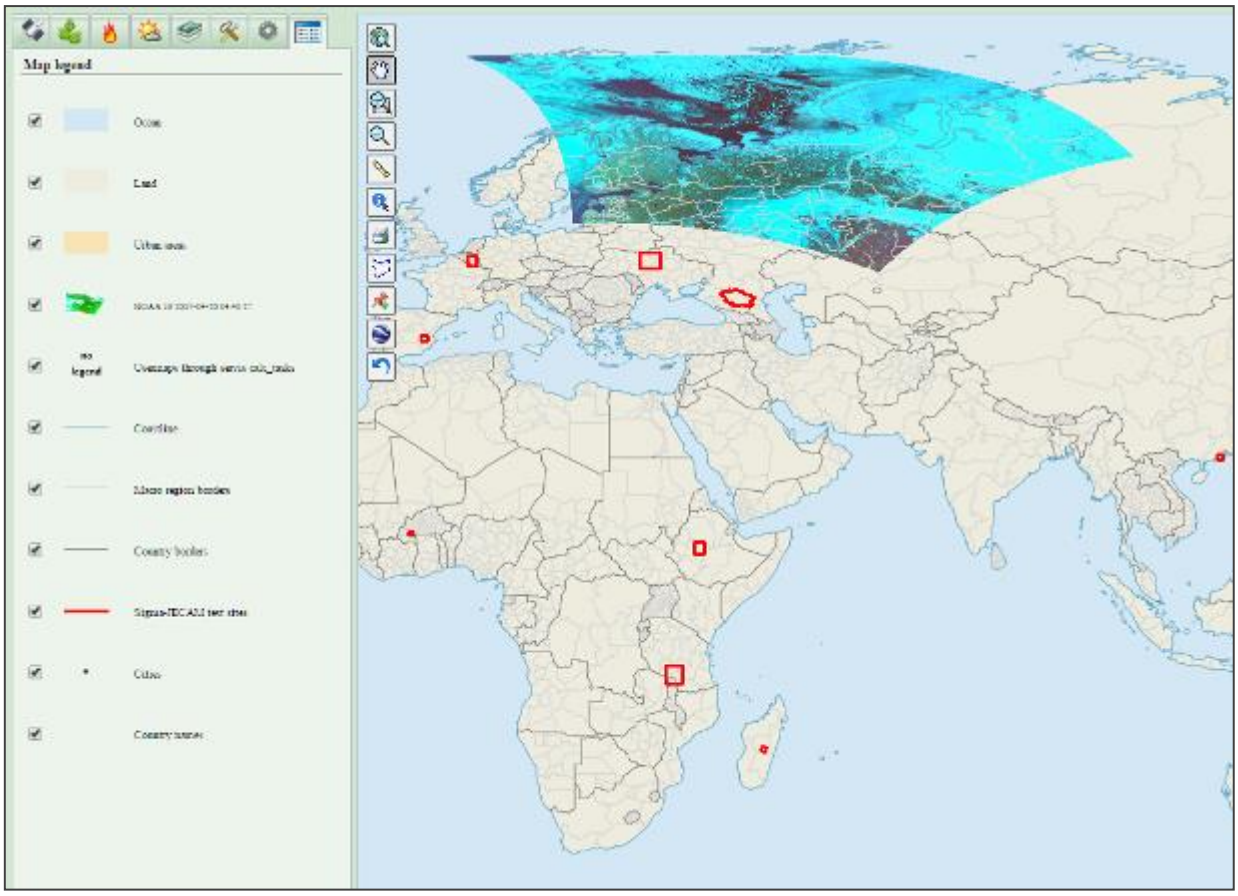
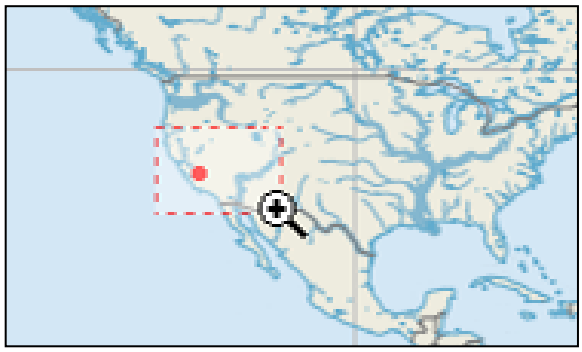


Figure 10: Map Legend Tab. NOAA image and the base layers are displayed.

Map navigation

There are two ways to find you area of interest (AOI) on the map in VEGA-GEOGLAM:

1. Manual navigation



→ Click Zoom **In** and draw a rectangle around any area;
→ Use **Zoom in- Zoom out (**or mouse scroll) and **Pan** ;
→ If you need to step backward to the previous extent click **Return** ;
→ Use **Query** to get the coordinates of a point;
→ **Full extent** brings you to the world map.

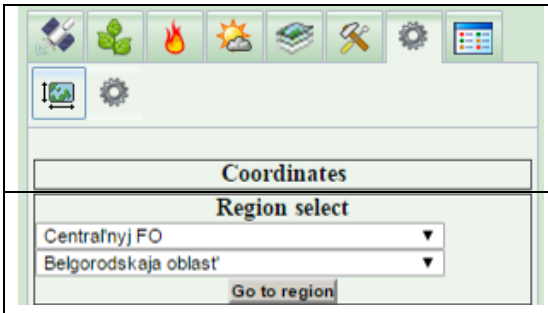
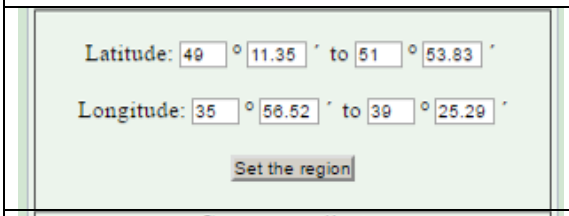
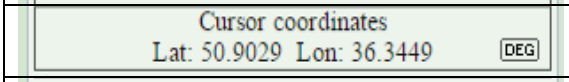
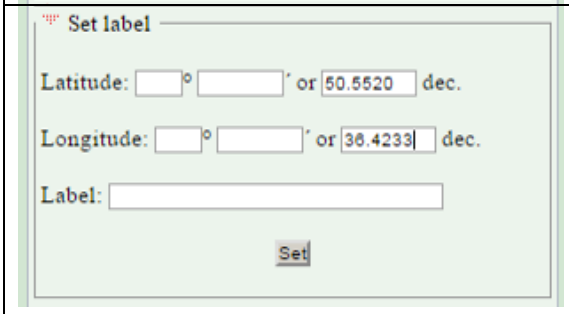
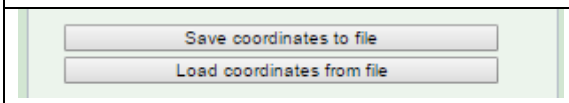
Figure 11: Zooming in to AOI

2. Navigation with coordinate setting

→ Go to **Navigation and Reprojection** → **Coordinates**

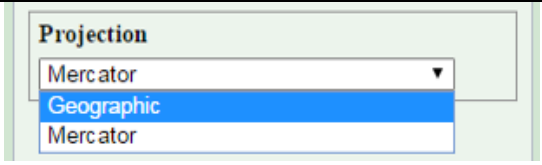
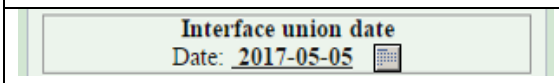
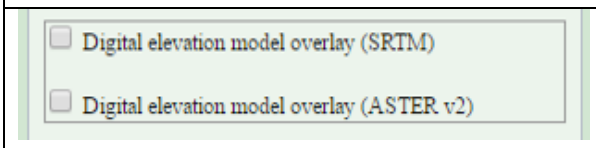
There are four options:

a) Search by Region
b) Set the Range of coordinates
c) Set the Label
d) Load a file with coordinates

	Turn on/off the Coordinates tab
	<u>Search by region</u>. → At the drop-down **Region Select** list first select the macro region, then the relevant region; → Click **Go to region.** You'll be navigated to the selected region.
	<u>Set the Range of coordinates.</u> If you want to open the specified extent, you can set the Range of coordinates.
	Cursor coordinates
	<u>Set the Label.</u> Set Label option creates a label (pointer)  on the map: use it if you know the coordinates of extent center (of the one point): → Open **Set label** block; → Set Latitude, Longitude, Label name; → click Set; → **Zoom in** to the label.
	<u>Load a file with coordinates</u>. You may save/load a file with coordinates of the visible extent. This instrument is useful when you work regularly with the same area. VEGA saves the visible extent in *.txt file. You can open, rename and resave this file to the proper folder.

Projections and Digital Elevation Models

→ Go to **Navigation and Reprojection** → **Interface parameters**

	Turn on/off the Interface parameters tab
	<u>Projection setting section.</u> A map projection is a systematic transformation of the latitudes and longitudes of locations on the surface of a sphere or an ellipsoid into locations on a plane. There are two available projections in VEGA-GEOGLAM: Geographical and Mercator projections. Geographical projection is set as default.
	<u>The interface union date.</u> This option allows setting the union date for all the Tabs from Satellite Data and for Fires and Meteorological data tabs to simplify the data search.
	<u>Digital Elevation Model</u>. Digital Elevation Model (DEM) is a digital model or 3D representation of a terrain's surface. There are two digital elevation model overlays in VEGA-GEOGLAM: SRTM and ASTER v2. To set the DEM: → Go to **Navigation and Reprojection** → **Interface parameters;** → Select SRTM or ASTERv2 DEM.

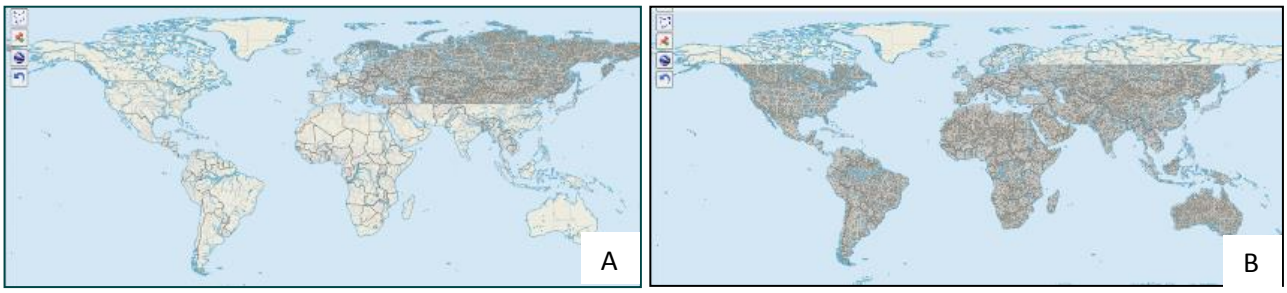


Figure 12: Digital elevation Model cover: a) ASTERv2, b) SRTM

Projection setting:
To switch to Mercator projection:
→ Go to **Navigation and Reprojection → Interface parameters**;
→ At the **Projection** section in the drop-down list select Geographical or Mercator projection.

III. VEGA-GEOGLAM Data & Tools

Built as a geospatial information web-service, VEGA-GEOGLAM gathers EO data and other geographical information from different sources and provides access to it along with tools for integrated on-line data analysis to users worldwide. Figure below illustrates VEGA-GEOGLAM data coverage.

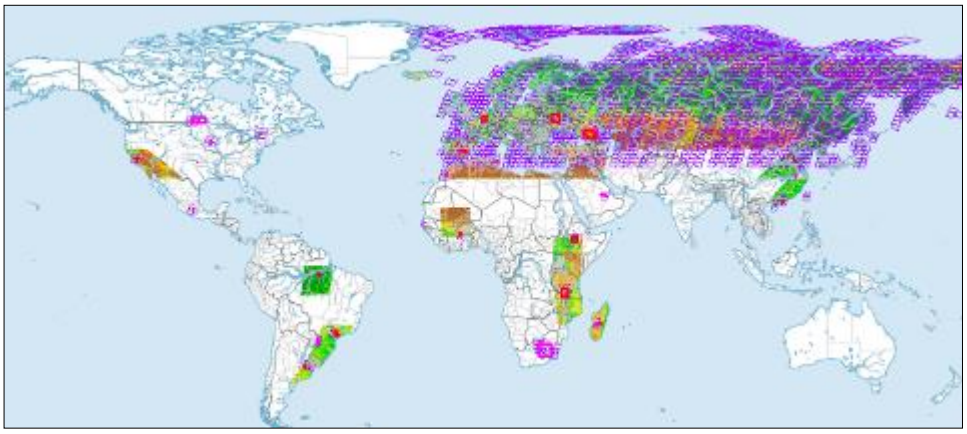


Figure 13: VEGA-GEOGLAM collects data over the all SIGMA/JECAM test-sites, which covers many agricultural valuable regions.

The EO data, available on VEGA-GEOGLAM, is described in table 3. VEGA-GEOGLAM is potentially open to include other EO data, which can be provided by the SIGMA project partners and under their requests.

Table 3. VEGA-GEOGLAM data

Type of data	Description	VEGA-GEOGLAM Tab
Satellite Imagery	Satellite images are source of actual and reliable information. High, middle and low resolution images from different, including Russian satellites, are available. Users can choose image with filter and search tools for the area of interest. List of available satellite imagery see at Table 3.	Satellite data
NDVI time series	An access to the multi-year NDVI and meteorological data time series is one of the main advantages of VEGA-GEOGLAM. Data is cleaned and normalized by automatic algorithms; multi-year NDVI series are calculated. On the basis of such homogeneous data series, multiannual NDVI mean (the “norm” or the standard) for the development of different types of vegetation (winter and spring) is calculated. Crop development trend comparison with such norm, is, in turn, one of the key opportunities for the crop condition assessment.	Graph Interface
Meteorological data	Downloaded 6 times a day from NCEP Reanalysis data set (source: http://rda.ucar.edu/datasets/ds093.0/#metadata/grib2.html?_do=y).Meteorological data is available at the level of user defined objects (fields) for the period from 2001 to current date. List of available meteorological data find at Table 5. All the data is downloadable in .CSV format.	Meteorological data
Field data	In-situ data includes data provided by project partners for the SIGMA-JECAM test sites (crop types, phenological phases, yield), national and sub-national information on agricultural statistics provided by project partners, field borders and other field information added by users to the “Passport of the Field”.	Agricultural data

Products (maps and masks)	This group includes base maps (country, county borders from OSM), digital elevation models and unique set of thematic maps created in Space Research Institute: maps of arable and non-arable lands, MODIS derived landcover maps and some other products.	Satellite data, Base Maps
Fires on agricultural and non-agricultural lands	Fire spots detected with MODIS Thermal Anomalies/Fire MOD14 product and combined into clusters using IKI technologies. A type, the borders, data start and finish of fire, amount of hectares are available for each “fire” object.	Fires

The data archive, based on satellite imagery, has been established since 2000 and updated every day. Images are downloaded from open image data archives as soon as they become available. Available data comes from external and internal sources, such as USGS, NCEP portals, Terrestrial Ecosystem Monitoring Laboratory of the Russian Space Research Institute. Satellite images are pre-processed (most of them go through atmospheric and radiometric corrections).

VEGA-GEOGLAM users have access to multispectral images, radar images, and images received from Russian satellites (see table 4). Available Earth Observation data has a spatial resolution in a range down to 1 meter.

The wide range of available images allows us to solve different tasks: there are frequently updated images, like MODIS images, that allow us to make seasonal sets of images and track the fields dynamically, to control the land usage. Also there are images with extremely high spatial resolution, where every spot is clearly visible, but the frequency of updates is relatively low - these kinds of images fit perfectly for image interpretation and border drawing, for land use map creation. The choice of the image depends on the task to be solved.

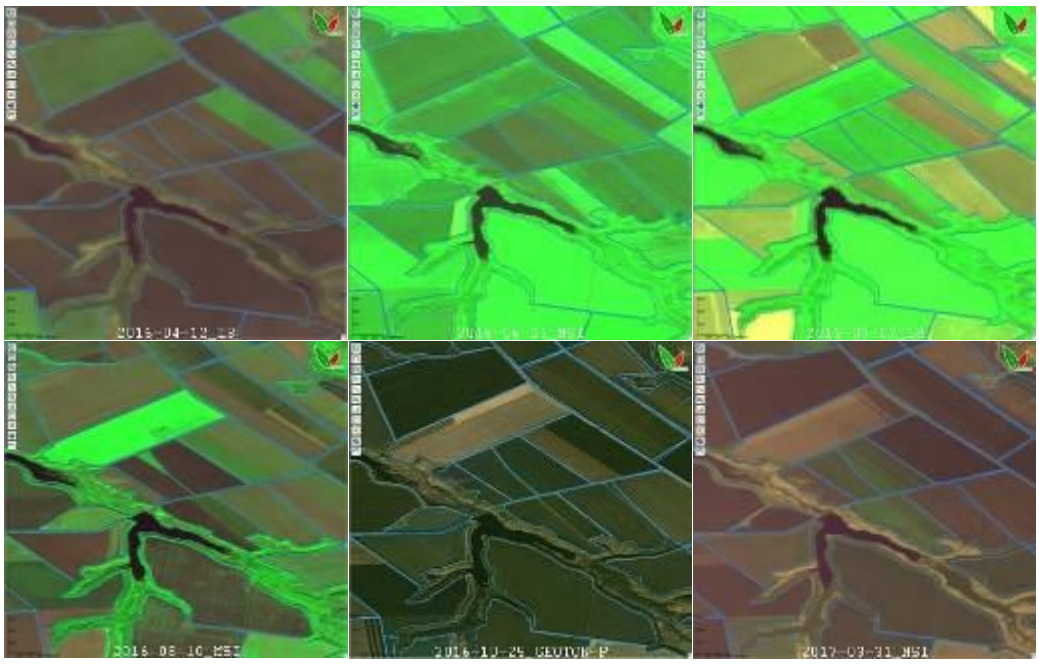


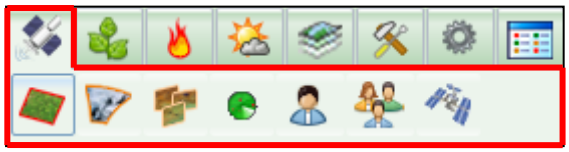
Figure 14: MSI Sentinel-2A images collection for the summer season 2016 in Kursk region. Satellite images allow users to assess visually field conditions, vegetation heterogeneity on the fields, to control the agricultural works, to detect the erosion processes dynamics and more.

Table 4. VEGA-GEOGLAM EO data archive

Sensor	Satellite	Product	Downloadable	Spatial resolution	Comment
High resolution data					
Hyperion	Earth Observing 1 (EO-1)	L1 standard product	yes	30 m	Hyperspectrometer
TM, ETM+, OLI-TIRS	Landsat 4, 5, 7, 8	Level 1T standard product	no	15 m panchromatic, 30 m other bands	
SLIM-6	DEIMOS-1	L1T orthorectified product	no	22 m	Commercial satellite, data is contributed for the project
MSS, PSS	Canopus-V	L1 standard product	yes	2.1 m panchromatic, 10.5 m other bands	
KMSS-50,101,102	METEOR-M1,M2	L1A standard product	yes	60-120 m depending on the band	
GEOTON-P, SHMSA-SR, SHMSA-VR, GSA	Resurs-P	L1 standard product	yes	GEOTON-P: 70 cm panchromatic, 3-5 m other bands. SHMSA-SR: 60 m panchromatic, 120 m other bands. SHMSA-SR: 12 m panchromatic, 23.8 m other bands. GSA (hyperspectrometer): 25-30 m.	
MSI	Sentinel-2A		yes	10 - 60 m, depends on the band	
Moderate resolution data					
MODIS	Aqua (EOS PM-1), Terra (EOS AM-1)	Level 1 Data Products	yes	250 m (bands 1-2), 500 m (bands 3-7), 1000 m (bands 8-36)	
AVHRR	NOAA (15-19)		no	1100 m	
MSU-MR	METEOP-M1,M2		no	1000 m	
VIIRS	Suomi-NPP		no	750 m	
Radar data					
C-SAR	Sentinel-1A, 1B		yes	Depends on the mode, from 4x5 m (stritmap mode)	
ASAR 12.5m, 75m	Envisat		yes	30 m	
SAR	ERS-1		yes	25 m	

EO data

There is a special Group of tabs to work with Satellite Image Archive - **Satellite Data.** The tabs are:



- High resolution images
- Moderate resolution images
- Cloud-free composites
- Radar images
- My products
- Public products
- Data from ISS (International Space Station)

Here you can find and view satellite images and derived products, such as thematic band syntheses. Adding images to the Basket allows to download them and to work with them using VEGA-GEOGLAM tools.

Satellite data searching and viewing

The general steps to work with Satellite Data tabs are:

1. Navigate to your AOI;
2. Go to **Satellite Data;**
3. Depending on necessary resolution go to the appropriate tab;
4. Set search parameters using **Filter** (date, device, satellite, cloudiness);
5. Explore the search results and if there is suitable image:
6. Select the image in the Data list;
7. Turn on, if necessary, Autonormalization (histogram auto adjustment);
8. Select, if necessary, a product from the Products ("color" synthesis is set as default);
9. Put the image to the **Basket;**
10. Repeat steps 6-10 for other images, if necessary.

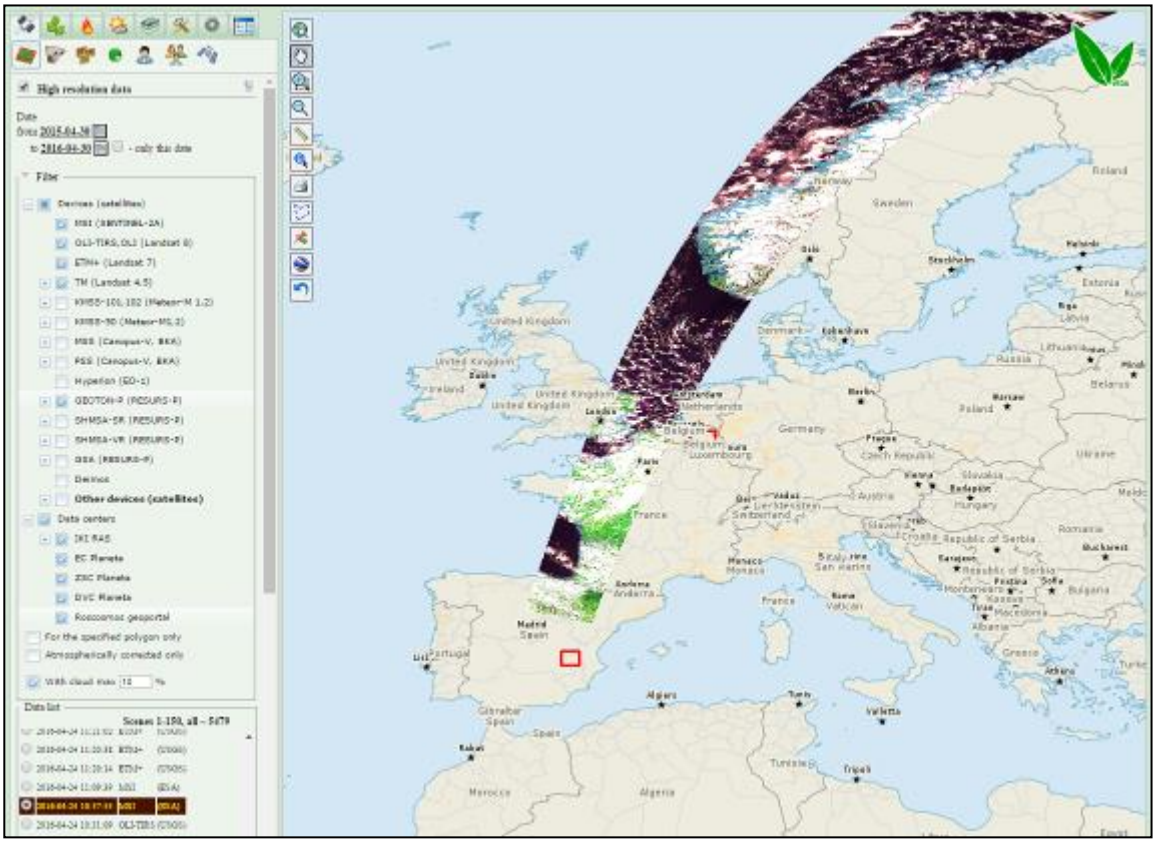
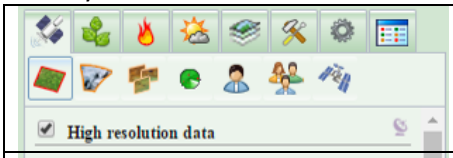
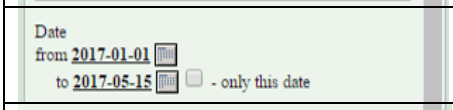
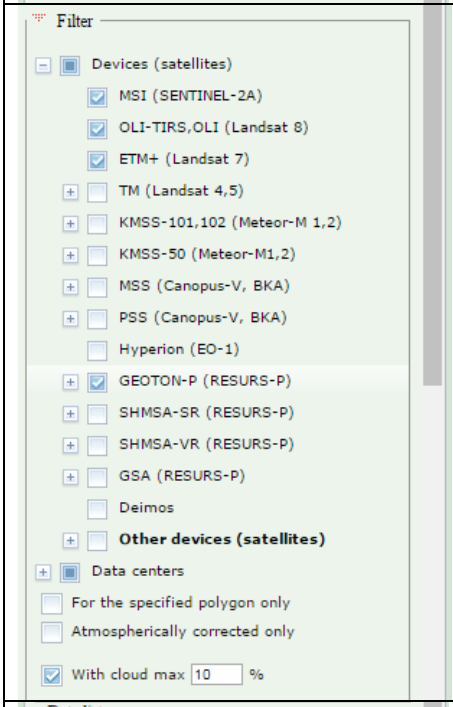
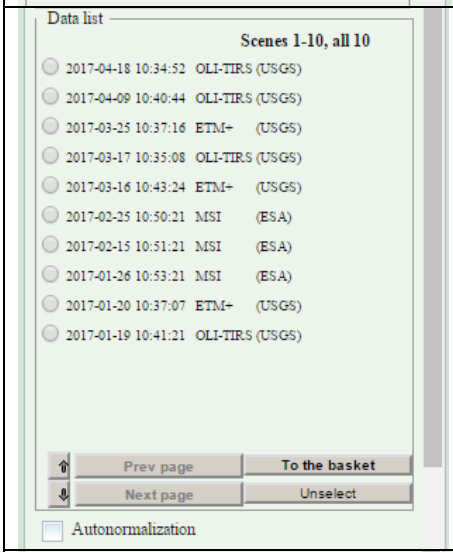
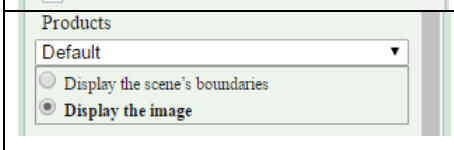
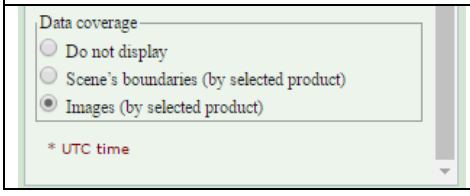


Figure 15: VEGA-GEOGLAM interface with an active High resolution data tab. MSI Sentinel 2-A scene is selected.

High resolution (HR) data

→ Go to **Satellite data** → **High resolution data.**

Here you can find and view Sentinel-2A, Landsat (4,5,7,8) Canopus-V and other HR satellite imagery .

	Turn on/off the High resolution data tab. High resolution images tab has a displaying priority.
	Date period to search images
	Satellite Filter : 1) Select required device (satellite); 2) Select data centers (sources of images); 3) For the specified polygon inly – draw a polygon with the **Draw**  tool to restrict the search extent; 4) Atmospherically corrected only – search images that were atmospherically corrected; 5) Set the cloudiness limit (for the entire scene).
	Search result list with the buttons: Next page, Previous page - to scroll result; Unselect – unselect selected image; To the basket - put an image to the **Basket.** Autonormalization option is image histogram auto adjustment.
	Available derived product list for the chosen image: choose any available product (see the description in High resolution data Product list chapter) for the chosen satellite image in Product list. Unavailable products marked in grey. Product (chosen image) displaying options: show product's boundaries or images.
	Displaying options for all search results (show scene's boundaries (fig 14, a) or images (fig. 14, b) or do not display both). Satellite image time is in UTC (Coordinated Universal Time) for the all images.

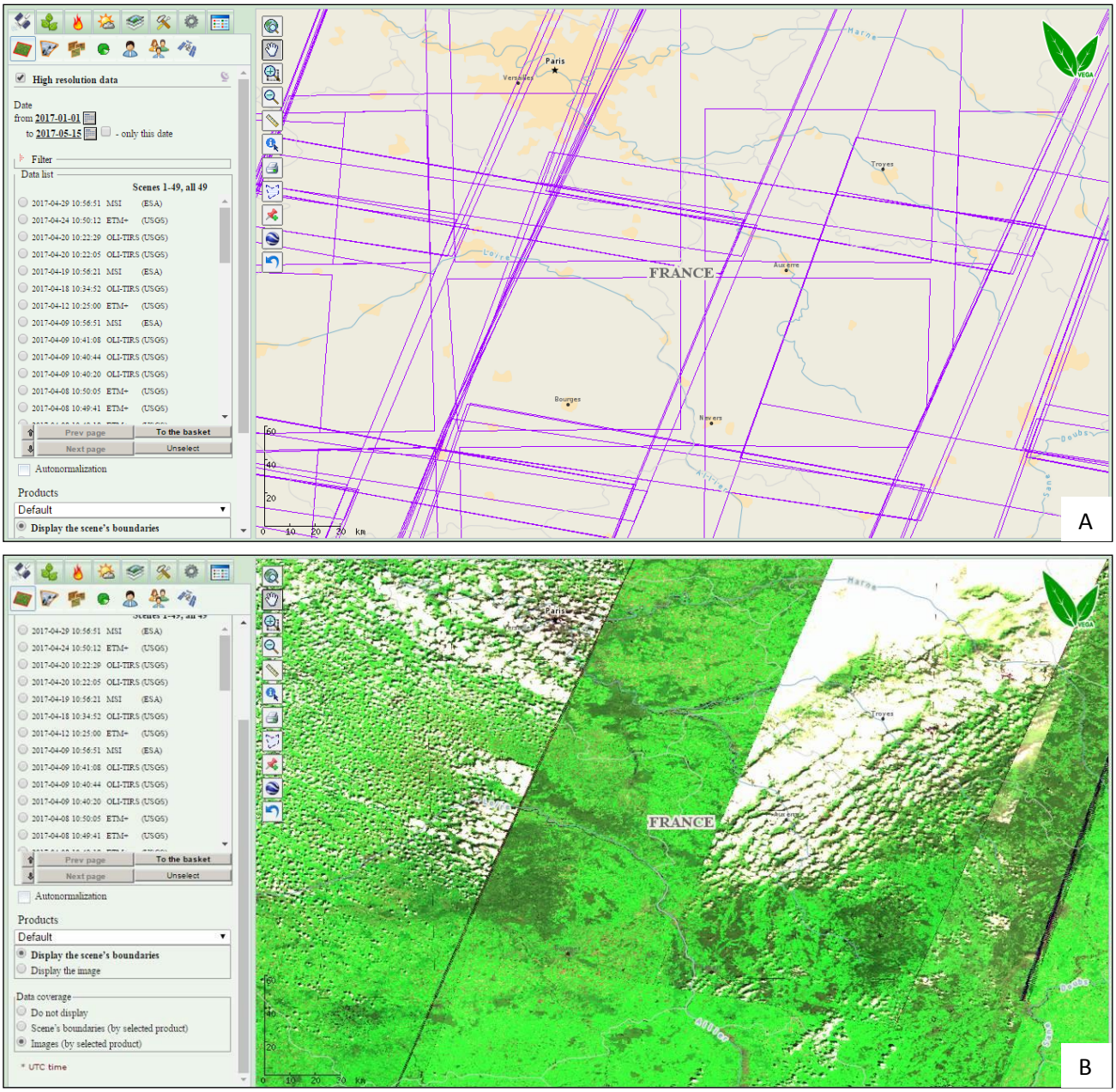


Figure 16: High resolution EO data tab. a) Scene's boundaries displaying; b) Selected images displaying.

High resolution EO data products list

Products are band combinations - thematic band synthesis, that allow you to see definite objects (fire or forest or snow or surface) more clearly at the image. For different satellites, you may choose different products.

For example, there is increased resolution product for Landsat ETM + - : it is creating by merging the 15-m resolution panchromatic band with the 30-m resolution data. There is NDVI map product available for the Landsat and Sentinel imagery (and also for the moderate resolution images, see the Moderate resolution Product list chapter).

To get NDVI map for high resolution satellite images:

→ Navigate to your AOI;
→ Go to **Satellite Data** → **High resolution data** tab**;**
→ Set the **Date period ;**
→ Set search parameters using **Filter** (date, device, satellite, cloudiness);
→ Find and select an appropriate satellite image;
→ In **Products** from the drop-down list select **NDVI;**
→NDVI map for the selected image would be displayed**.**
You may put it to the Basket for the further work or for downloading.

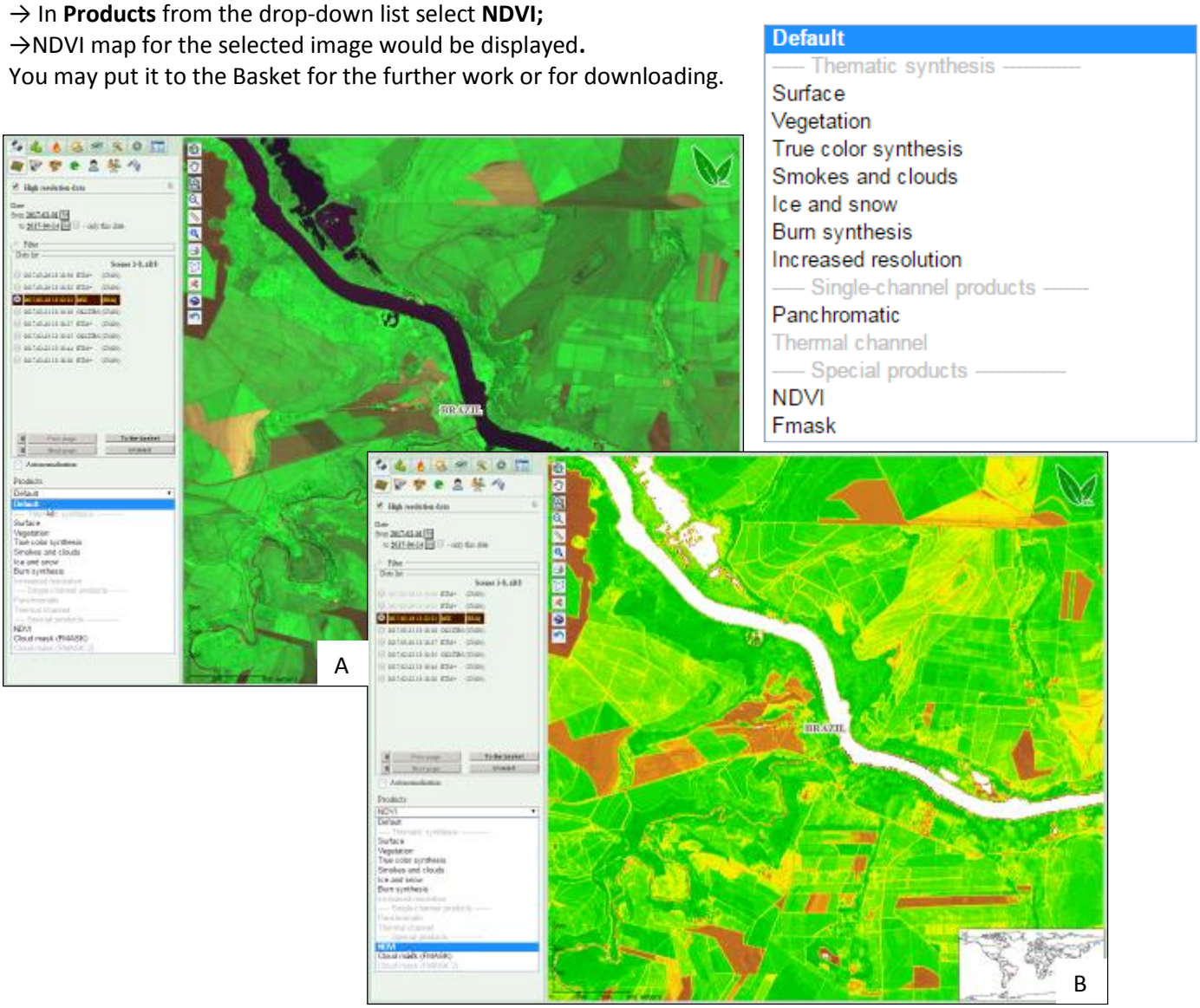


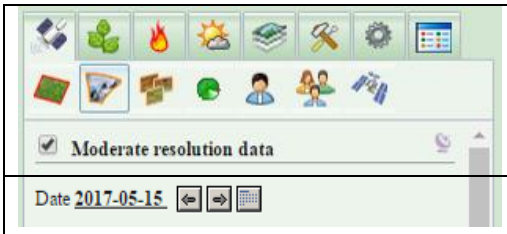
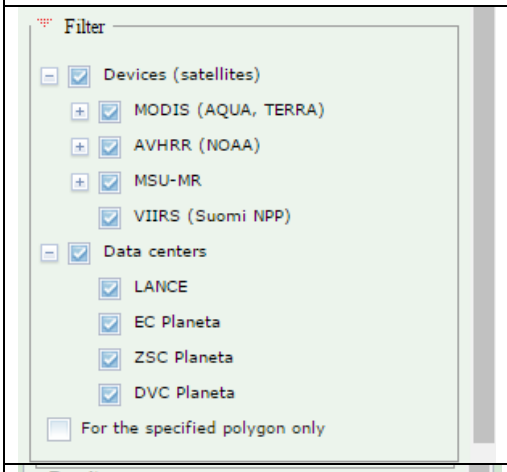
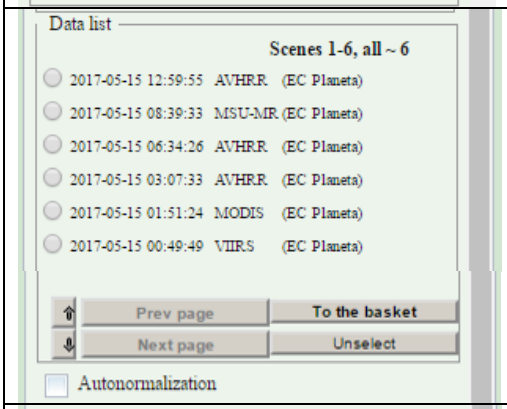
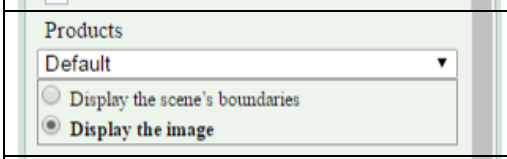
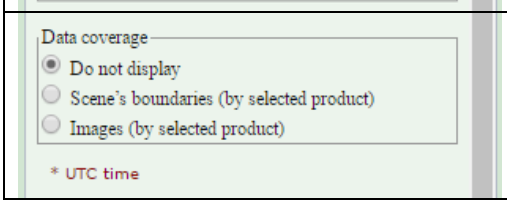
Figure 17: High-resolution images fit perfectly with the image interpretation.
Image - 2017-03-16 13:22:21 MSI (ESA); -22.50 Lat -48.60 Lon (Brazilian SIGMA-JECAM test-site).
a) Default product - we can detect deep (clean) water in dark blue colors and polluted (shallow) water in brighter, purple, colors; b) NDVI map fits for the vegetation condition assessment – in brown are bare soils, deep green represents healthy vegetation, poor vegetation is in yellow.

Moderate resolution (MR) EO data

The moderate resolution EO data are acquired by the following satellite instruments:

- MODIS (AQUA, TERRA);
- AVHRR (NOAA);
- MSU-MR (Meteor-M1, M2);
- VIIRS (Suomi NPP).

Usage of the MR EO data tab is similar to the High resolution EO data tab.

	Turn on/off the Moderate resolution tab
	Set the Date to search images (there is no option to set the period of dates because of high frequency of images updating)
	Satellite Filter : 1) Select required device (satellite); 2) Select data centers (sources of images); 3) For the specified polygon inly – draw a polygon with **Draw** tool to restrict the search extent;
	Search result list with the buttons: Next page, Previous page - to scroll result; Unselect – unselect selected image; To the basket - put an image to the **Basket.** Autonormalization option is image histogram auto adjustment.
	Available derived product list for the chosen image: choose any available product for the chosen satellite image in Product list. Unavailable products marked in grey. Product (chosen image) displaying options: show product's boundaries or images.
	Displaying options for all search results (show scene's boundaries or images. Satellite image time is in UTC (Coordinated Universal Time) for the all images.

Resolution of these images is not as good as high-res satellite's, but it's time resolution is much bigger: they come several times a day for a wide areas. This is the basis of continuous monitoring and cloud-free composite creation.

The MODIS images are usable for dangerous phenomena monitoring, such as tropical cyclones, volcanic eruptions, dust storms, large fires, floods. Example of moderate resolution imagery usage is presented below.

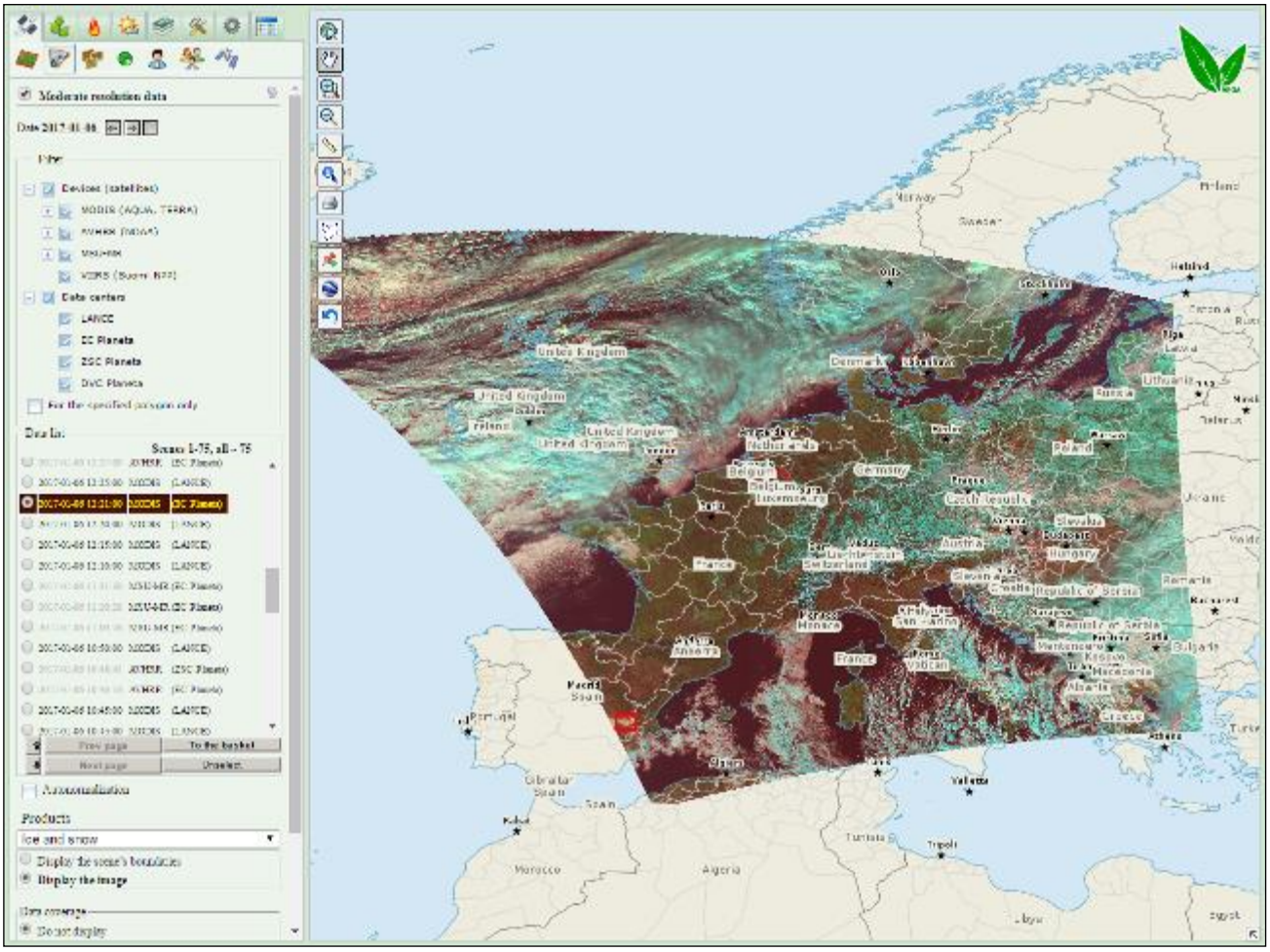


Figure 18: An example of a MODIS ((Moderate-resolution Imaging Spectroradiometer) image. The MODIS imagery has a wide range of applications for the study of the atmosphere, ocean and land.

Moderate resolution data usage example in the task of crop meteorological conditions assessment

The map at the figure 19 (**Vegetation analysis → Vegetation state analysis by district**) shows bad winter crop vegetation dynamics in 2013 year at Volgograd, Saratov, Samara and other regions, colored in red. NDVI values are 30% below the NDVI multiannual mean. This information suggests some crop losses. Using MR imagery we may perform snow cover evaluation and assess the negative winter weather factors: December frost with the lack of snow cover caused the plant losses.

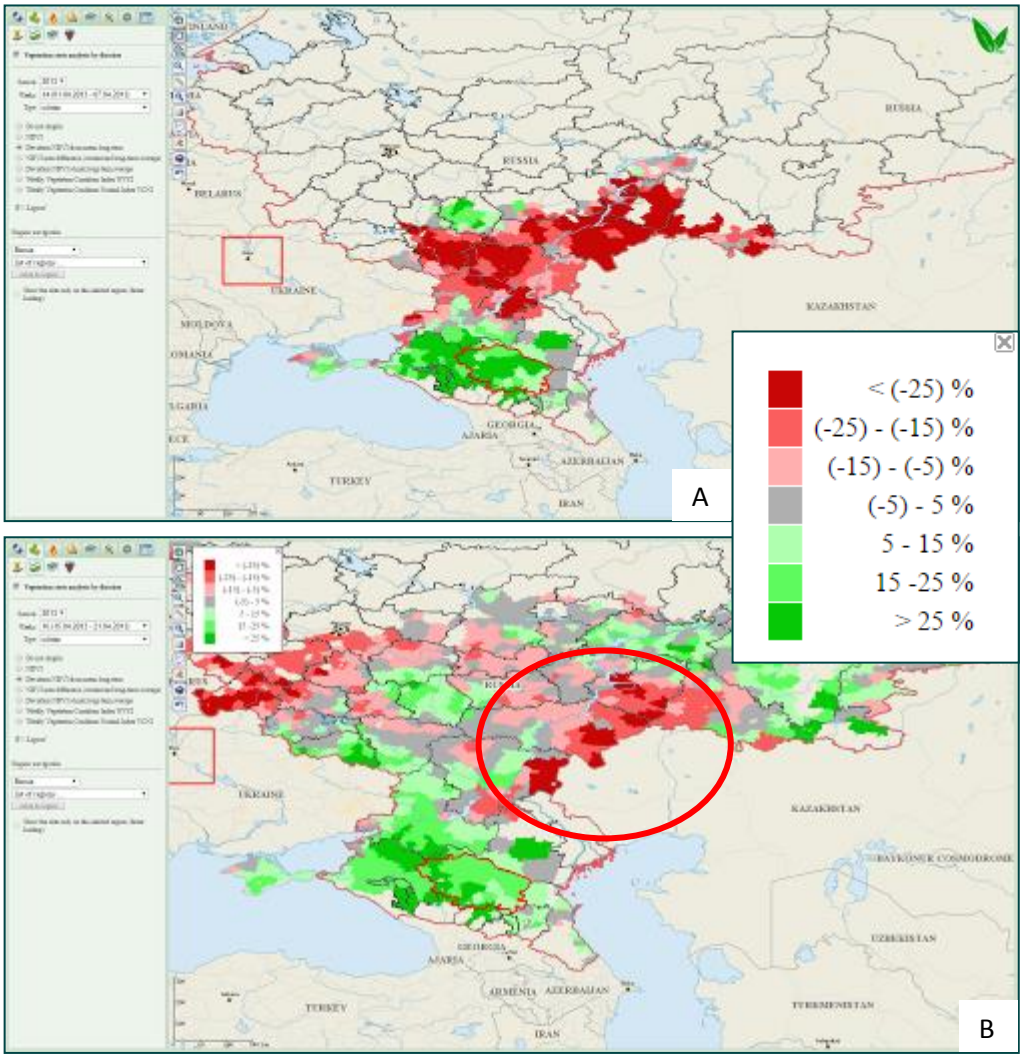


Figure 19: winter crop development NDVI cartograms (deviation from the multiannual norm) for the
a) week 14th of 2013;
b) week 16th of 2013.

At Figure 19:
Week 14 (01.04.2013-07.04.2013): winter crop NDVI deviation from long-term average map shows that there are problems in early crop development after the winter in a number of Russian regions (red ones at the map).
Week 16 (15.04.2013-21.04.2013): two weeks later the situation became less critical but in some regions the negative trend remains.

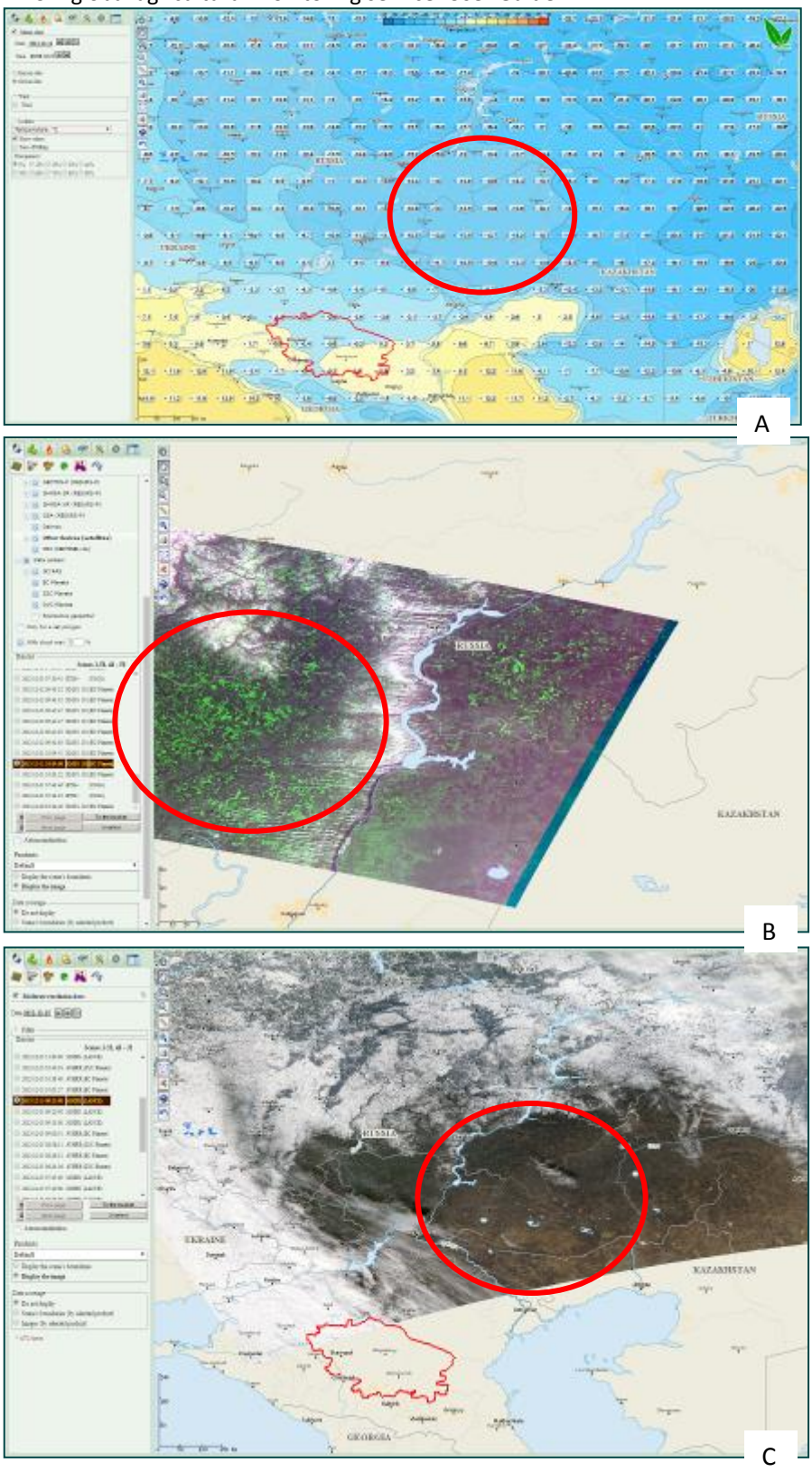


Figure 20: 2012-2013 season winter crop development. Snowless zones with extremely low temperatures marked in red.

At Figure 20:

a) Winter 2012-2013 conditions evaluation using Meteorological data. Picture shows the minimum temperature distribution in the south of the European part of Russia in 14.12.2012. Temperatures in December 2012 were up to - 20°C, what is normal to crops if there is snow cover, but rather critical without it. b) Snow cover evaluation with 2012-12-11 KMSS-102 image. Picture shows snowless zones, winter crops fields are in green, covered with snow zones are in white; c) Snow cover evaluation with 2012-12-15 MODIS image. Picture shows the snowless zones.

Low temperatures and low snow cover caused winter crop damaging in a number of Russian regions.

Moderate resolution Product list

There are different products (band synthesis or processing results) are available for moderate resolution images. There are also channel data: a user can use it to make special band combinations or as is.

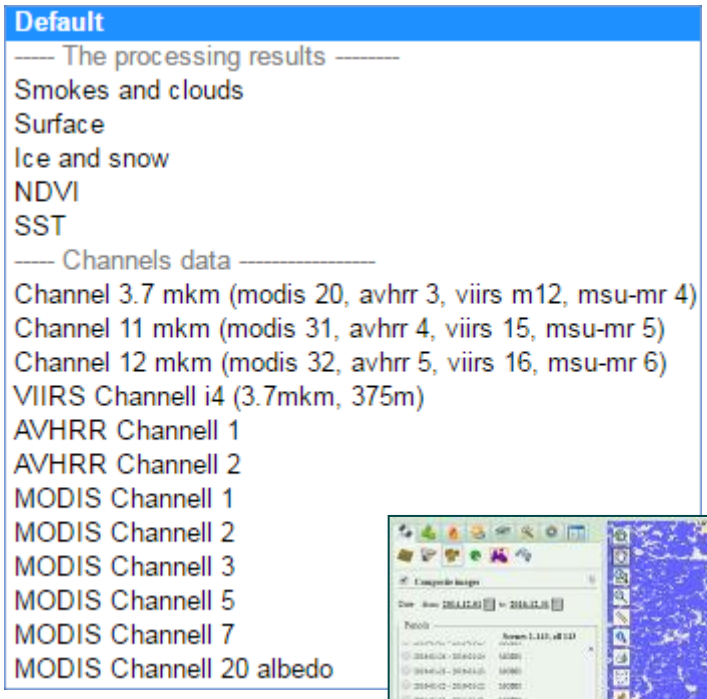


Figure 21: Moderate Resolution Product list

For example, there are **Daily MODIS Snow maps** available from 2015 . They can be used for monitoring and crop condition prediction.

→ Go to **Satellite Data** → **Composite images ;**
→ Set the **Date period ;**
→ As a **Type** of composite select **Daily composites;**
→ As a **Composite** select **Snow mask (MODIS).**

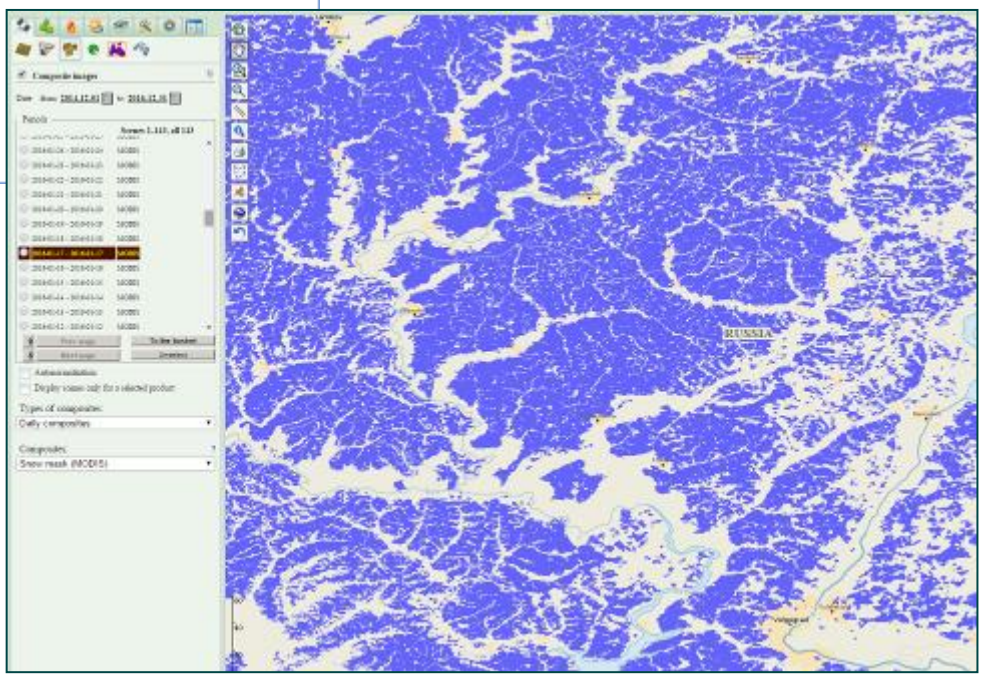
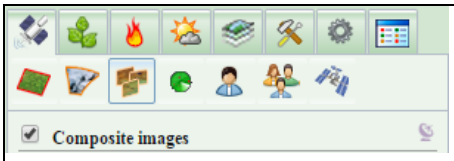
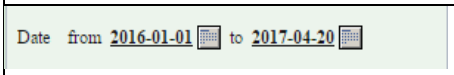
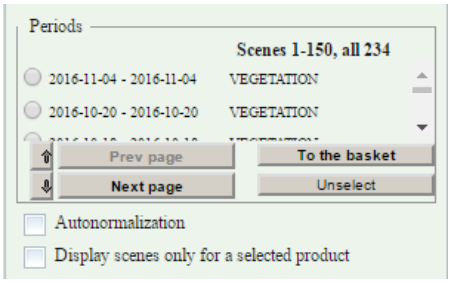
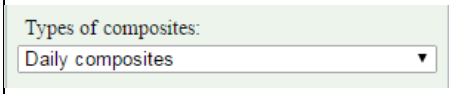
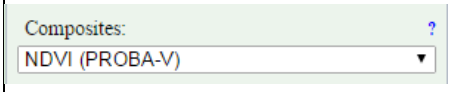


Figure 22: Daily MODIS Snow map

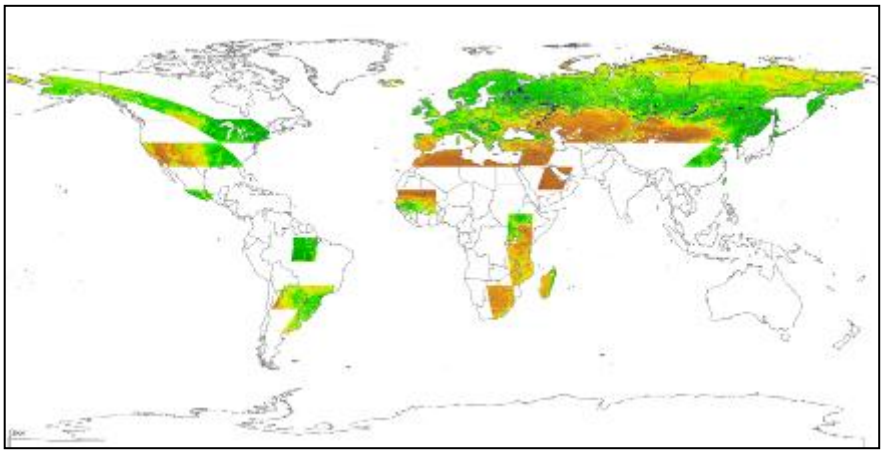
Cloud-free image composites

→ Go to **Satellite Data** → **Composite images**

	Turn on/off the Composite images tab
	Date setting
	Search results (available cloud-free composite images)
	Type of composite setting
	Select the composite

Cloud-free image composite is a combination of several images, where clouds and shadows are replaced with data from other dates. Combined images are radiometrically corrected and in a composite image can be analyzed as a single image for classification.

There are various Composite image products are available: Band synthesis, like Vegetation and Thermal anomalies for Landsat; Single bands, like NIR and RED channels for MODIS; Vegetation indices, like NDVI and LAI for MODIS and PROBA-V.



Composite images are aggregated by compositing period:

- Annual
- Seasonal
- Monthly
- Weekly
- 4-day
- Daily

Figure 23: MODIS NDVI weekly data composite for October 19, 2014

To work with composite images:

→ Go to **Satellite Data** → **Composite images;**
→ Set the **Date** period;
→ Select **Type** of composite (for NDVI there are Weekly, 4-days, Dialy cloud-free composites);
→ Select the **Composite** (satellite). Click on the question mark to see the description of an each product;
Available images would be displayed at **Periods.**
→ Select the composite image from **Periods.**

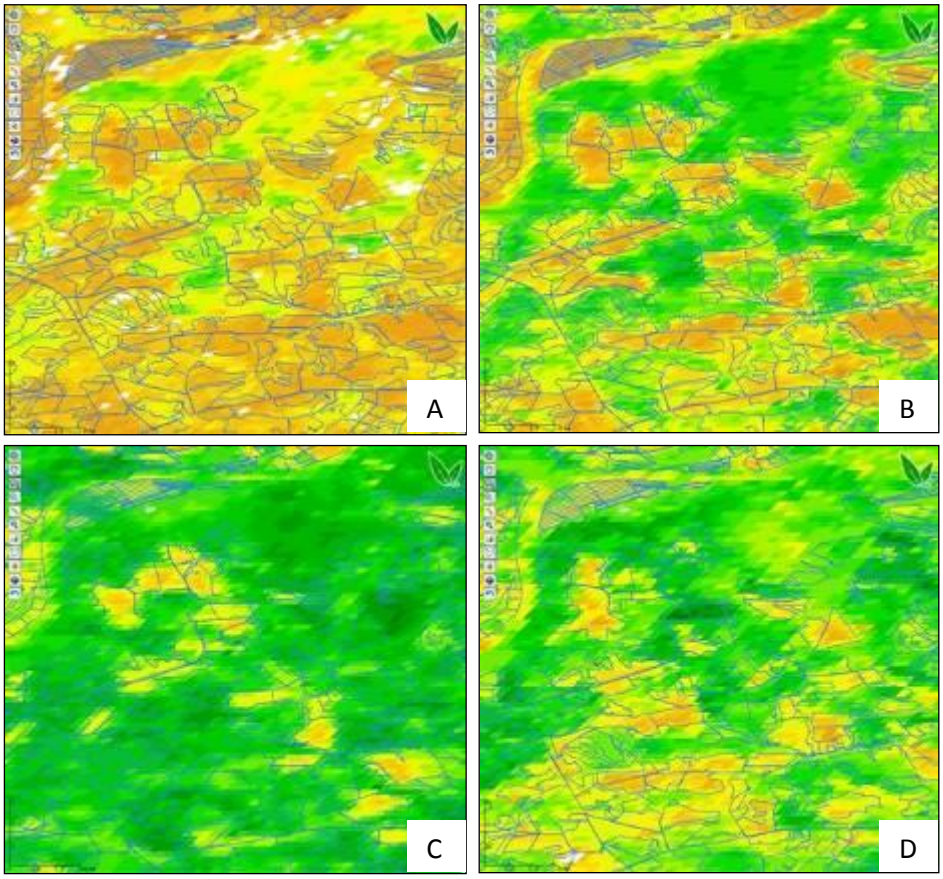


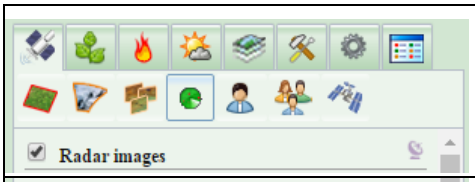
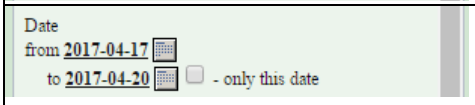
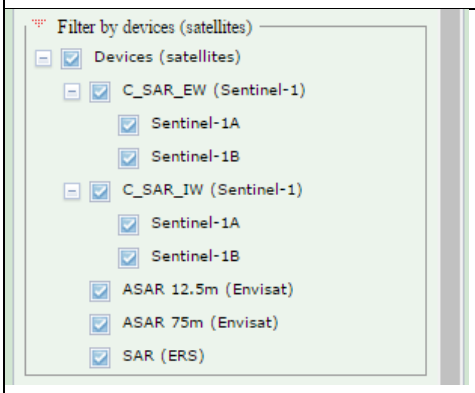
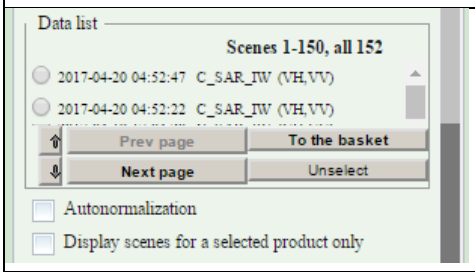
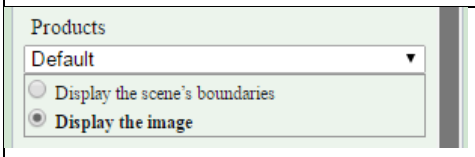
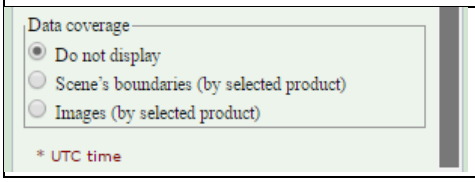
Figure 24: Biomass accumulation dynamic maps (weekly MODIS derived cloud-free composites) for the fields in Moscow region at the summer season 2016:

a) April;
b) June;
c) July;
d) September.

Radar data

→ Go to **Satellite Data** → **Radar data**

For Radar data there are images from: Sentimel-1 (C-SAR), Envisat (ASAR), ERS (SAR) satellites.
Radar images serve to develop new agricultural monitoring methods, they are widely used in Digital Elevation Model creating, in oil spills monitoring and water craft detection, in forest and agriculture land condition assessment.

	Turn on/off the Radar data tab
	Date setting
	Satellite Filter
	Search result list with the buttons: Next page, Previous page - to scroll result; Unselect – unselect selected image; To the basket - put an image to the **Basket**.
	Available derived product list for the chosen image: choose any available product and set the product (chosen image) displaying options
	Displaying options for all search results. Satellite image time is in UTC (Coordinated Universal Time) for the all images

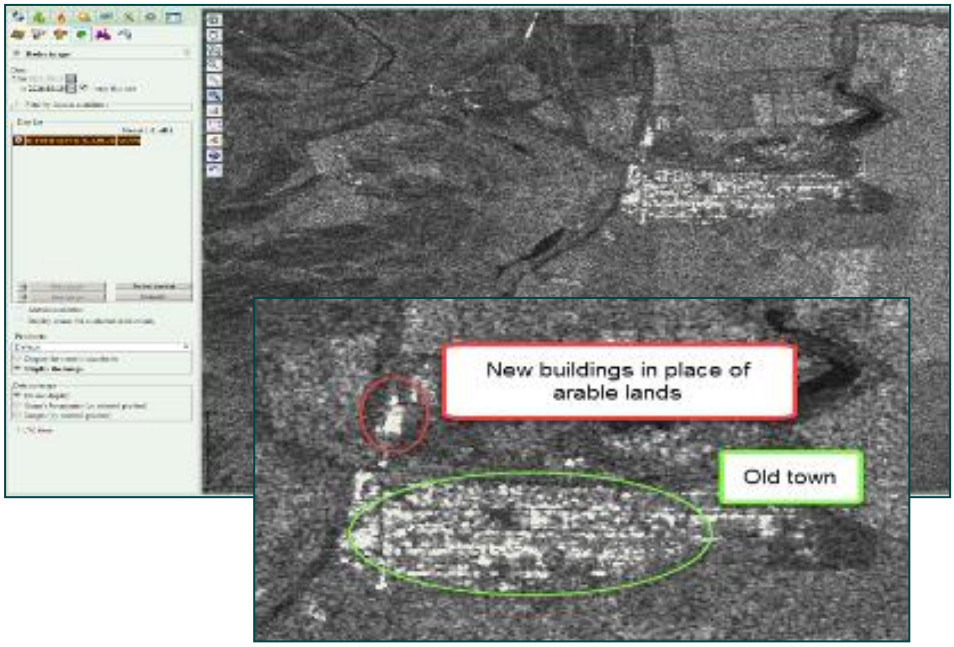


Figure 25: Here, on Sentinel-1 image, ***19.10.2016 21:44 C_SAR_IW (VH, VV),*** *we may clearly see the artificial objects (in white).*
They are detectable well due to multiple scattering; the buildings are kind of glowing. These new-built houses are constructed on the place of the former meadows.

Advantages of Synthetic Aperture Radar (SAR) compared to optical remote sensing
(Source *saredu.dlr.de*):

- All-weather capability;
- Frequent measurements during the short dynamic growing season of crops is possible;
- Independence of sun illumination day and night operation;
- Sensitivity to dielectric (water content, biomass) and geometrical (plant/canopy structure, surface, roughness) properties of the target complementary information to optical data.

Disadvantages of SAR data:

- Complex interactions (difficult in understanding, complex processing);
- Speckle effects;
- Topographic effects, radar shadow;

ISS data

Images from the International Space Station especially for the GEOGLAM project were taken (in 2015) and are available to view for VEGA-GEOGLAM user's observation of the JECAM sites at ISS data tab.

→ Go to **Satellite Data** → **ISS data** ;
→ Set the **Date** period, select phenomenon (fig 6, 1);
→ Turn on View ISS data to see where there are images on the map (fig 6, 2);
→ Zoom to the area of interest (fig 6, 3);
→ Using **Query** click at the red point (fig 6, 4).

Pop-up window with attributive information for the point opens (b).
Click on Images from ISS link to open the ISS image (c).

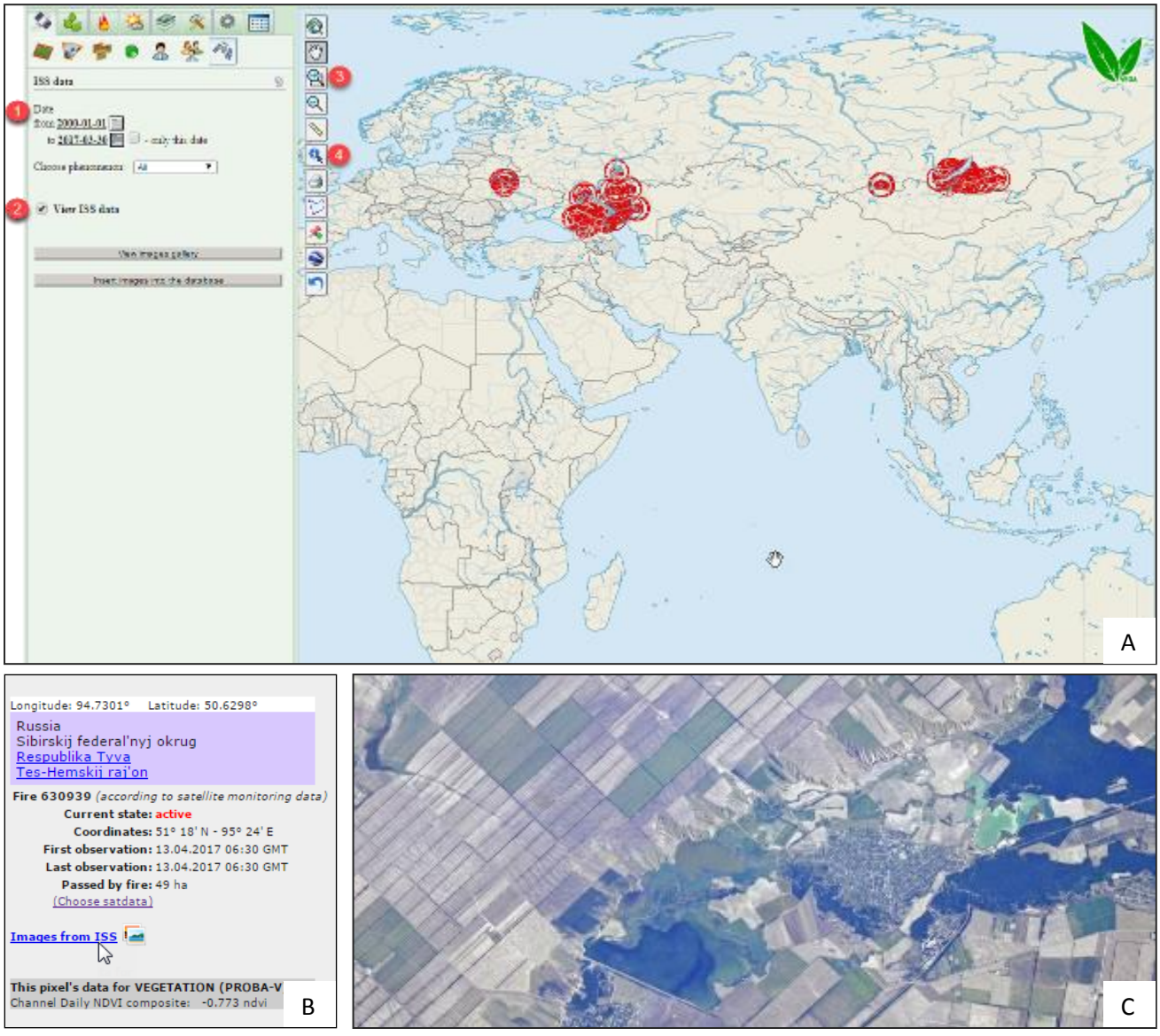
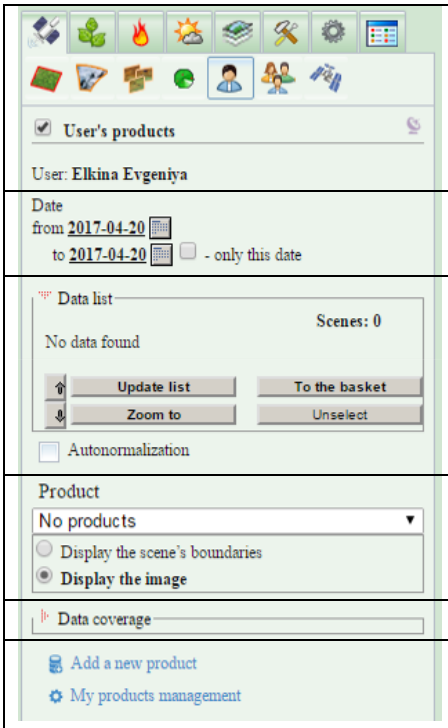


Figure 26: ISS data.

My products

Users can upload raster georeferenced (GeoTiff) files to the system.

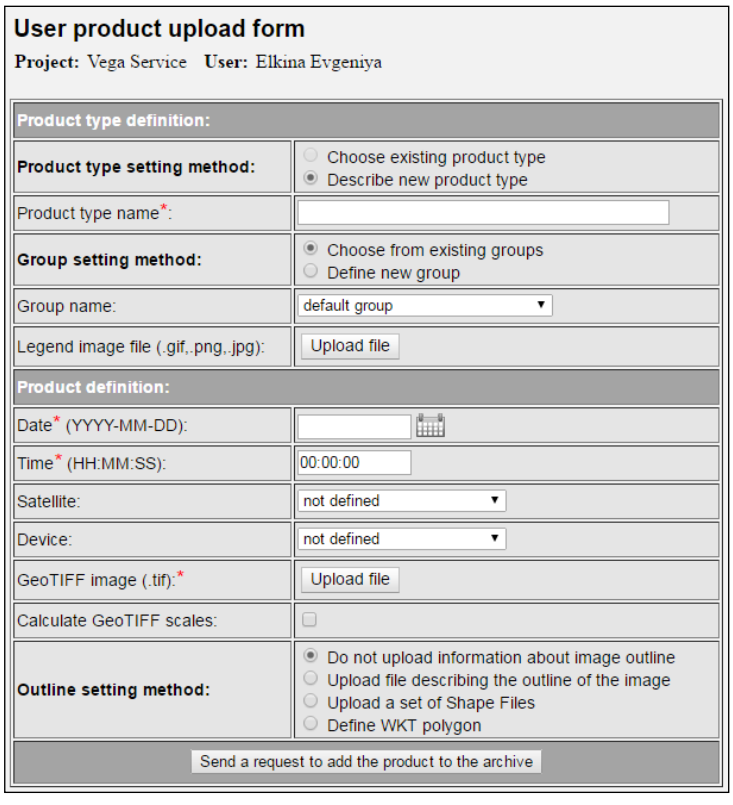
→ Go to **Satellite Data** → **My products**

	Turn on/off the My Products tab
	Set the date period to find the uploaded images
	List of uploaded images (product instances)
	Choose the product class from the Product list (or choose "All products")
	Set the product displaying options
	Add new product (file) – opens File Uploading form. To change description of uploaded product or to delete the product, use **My products management** option.

A user can upload raster file in GeoTIFF format to VEGA-GEOGLAM using special form.

To load your GeoTIFF file to the system:

→ Go to **Satellite Data** → **My products;**
→ Click on **Add a new product link.** Upload form opens;
→ Fill the form, describe and upload your file;
→ Click **Send a request to add the product to the archive**.
Uploaded product became available in VEGA-GEOGLAM in few seconds.



User product upload form

Project: Vega Service **User:** Elkina Evgeniya

Product type definition:	
Product type setting method:	○ Choose existing product type ◉ Describe new product type
Product type name*:	
Group setting method:	◉ Choose from existing groups ○ Define new group
Group name:	default group
Legend image file (.gif,.png,.jpg):	Upload file
Product definition:	
Date* (YYYY-MM-DD):	
Time* (HH:MM:SS):	00:00:00
Satellite:	not defined
Device:	not defined
GeoTIFF image (.tif):*	Upload file
Calculate GeoTIFF scales:	☐
Outline setting method:	◉ Do not upload information about image outline ○ Upload file describing the outline of the image ○ Upload a set of Shape Files ○ Define WKT polygon
Send a request to add the product to the archive	

Figure 27: file upload form.

Field data

Field (in-situ) data is stored in the Field Passport of VEGA-GEOGLAM. This information can be used for the joint analysis of ground and satellite data, for the field usage history assessment, for the cropland mapping and yield estimations.

A user enters the following information for an each field:

- Field borders
- Type of land
- Crop type
- Yield
- Phenological stages

Learn more about Field Passport editing options in the chapter Field Passport.

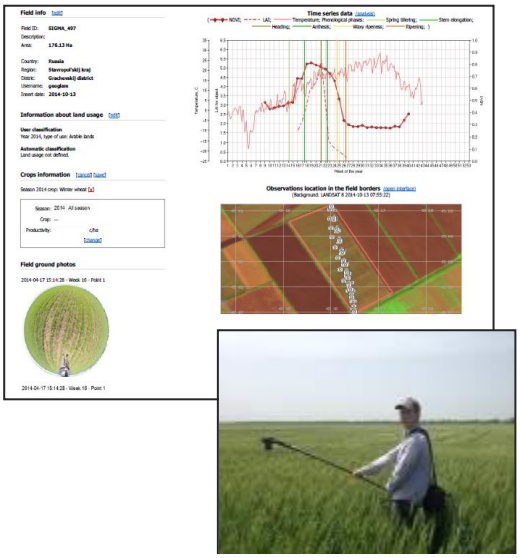


Figure 28: In-situ data collection

SIGMA/JECAM test sites data

One of the VEGA-GEOGLAM priorities is to facilitate combined EO and in-situ data analysis over the JECAM test sites (http://www.jecam.org/). SIGMA-JECAM activities, in which VEGA-GEOGLAM appears as a EO data analysis planform, are presented by various cropland mapping experiments over a variety of global cropping systems, methodologies developing and trainings.

One of the major challenges is sharing time series datasets from earth observing satellites and in-situ data. There are five JECAM test sites located in Russia, Ukraine, Argentina, China and Brazil with satellite and in-situ data provided by VEGA-GEOGLAM (Table 5). Also there are some test sites at the VEGA-GEOGLAM interface without the in-situ data, but the satellite data is continuously collected over them too. One of the VEGA-GEOGLAM priorities is to facilitate combined Earth Observation and in-situ data analysis over the JECAM test sites.

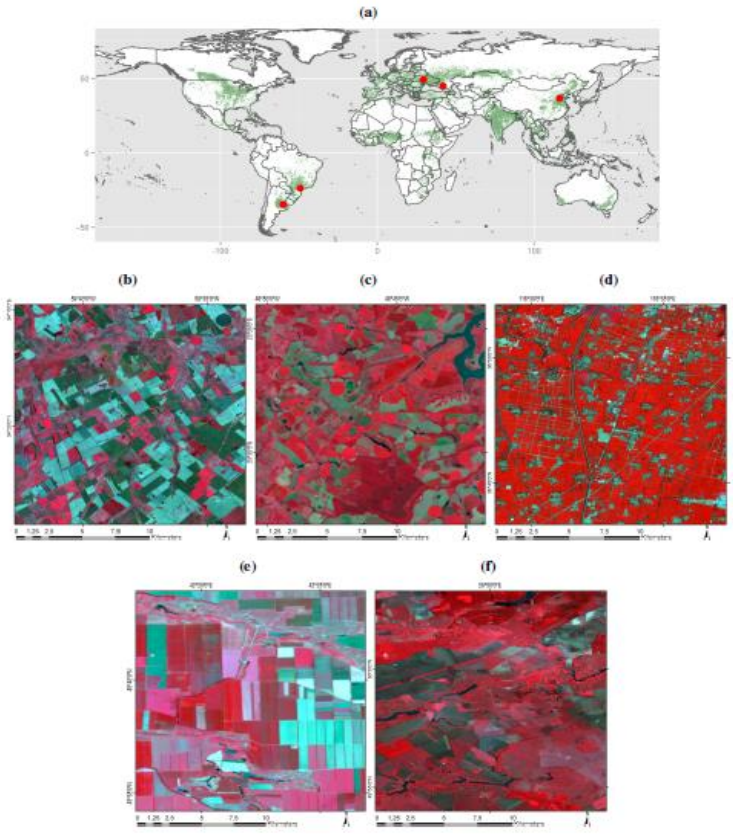


Figure 29. Location of the JECAM sites.Representative zooms of Landsat-8 false color composites in (b) Argentina, (c) Brazil, (d) China, (e) Russia and (f) Ukraine.

VEGA-GEOGLAM is open to the new data inputs. New data input is possible manually – through the Passport of the Field tool or automatically via Administrators or API.

Table 5. Available in-situ data over the JECAM test sites

Site	Amount of the fields	Crop data	Year
Argentina	348	Field borders, Arable/non-arable	2014
Brazil	847	Field borders, Arable/non-arable, Crop types	2014
China	189	Field borders, Crop types	2014
Russia	588	Field borders, Arable/non-arable, Crop types	2014, 2015
Ukraine	608	Field borders	2014

Test sites description

JECAM test sites present contrasted growing conditions and characteristics, management practices and crop calendars. Two of the study sites are located in South America (Brazil and Argentina), while the remaining three are located in Asia and Europe (China, Russia and Ukraine). To turn test sites border turn or off use the Base maps tab.

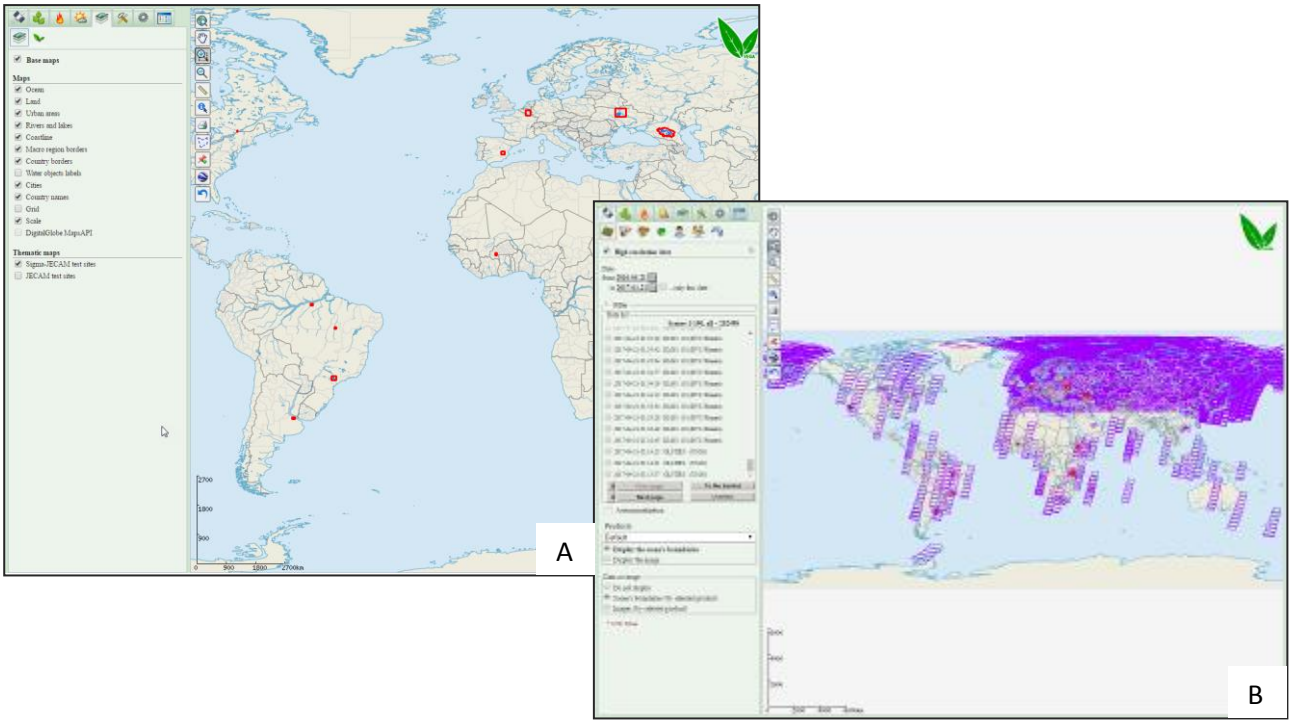
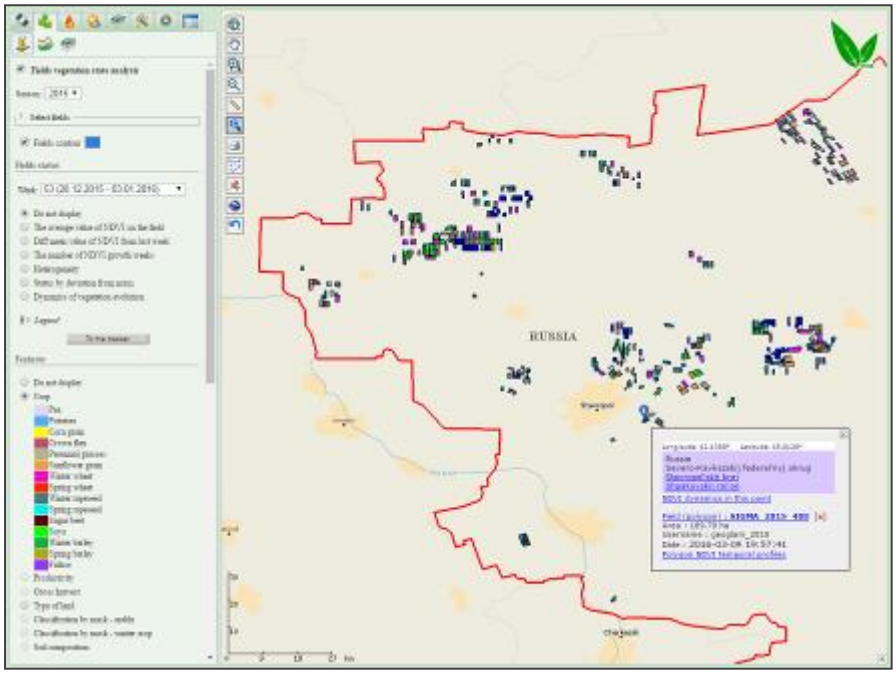


Figure 30: a) SIGMA-JECAM test sites borders in the VEGA-GEOGLAM map interface
b) The boundaries of the scenes, collected over the year (April 2016 – April 2017).The overall amount is more than 202 498 scenes of high and moderate resolution imagery

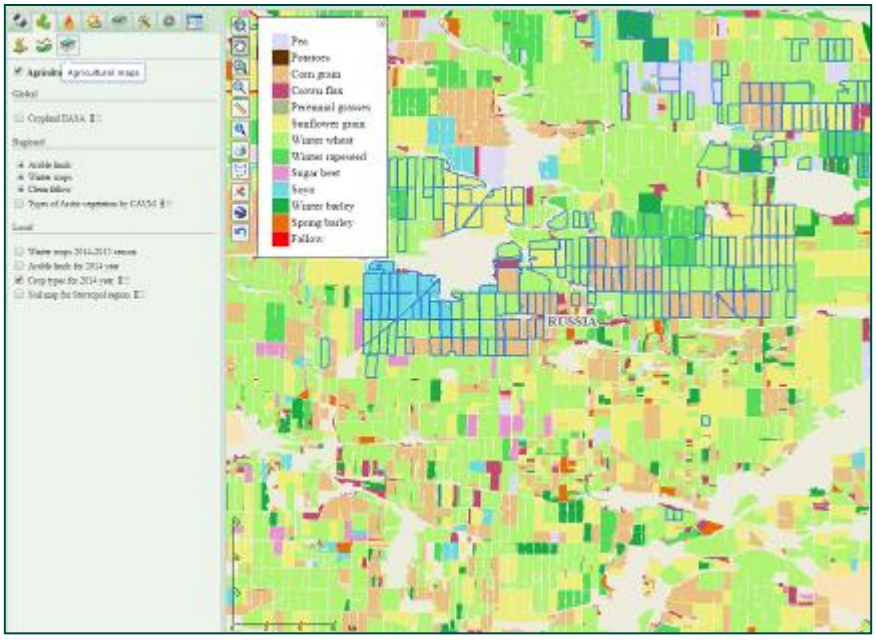
The Russian JECAM site (60-km by 85-km) is located in the Stavropol region (45°09' N, 42°08' E) (Figure 31). More than 80% of total region area is covered by agricultural lands.
To see the fields and in-situ data of Russian SIGMA-JECAM test site:



→ Navigate to **Russian SIGMA-JECAM test site (**Lat 45 Lon 43.2 - Stavropol region**);**
→ Go to **Fields vegetation state analysis;**
→ Select **Season: 2015**;
→ Open **Select fields** and select **All;**
→ Turn on **Fields contour**
You will see borders of the field (in blue);
→ Zoom to any group of fields;
→ In **Features** select **Crop.** You'll see crops of 2015 year in different colors.

Figure 31: Russian SIGMA-JECAM test-site

The dominating crops in Stavropol region are winter wheat, spring and winter barley, peas, soybean, sunflower, winter rape and perennial grasses with strong winter crop prevalence. The typical field sizes range from 30 to 130 ha. There are four main crop rotation types with several sub-types; changing from 2-years cycle with winter wheat and clean fallow in the arid Eastern parts to 8-years cycle including clean fallow, winter wheat, sugar beet, fodder maize, sunflower, spring barley and grain maize in the central and Western parts. In-situ data is a crucially important in cropland mapping.

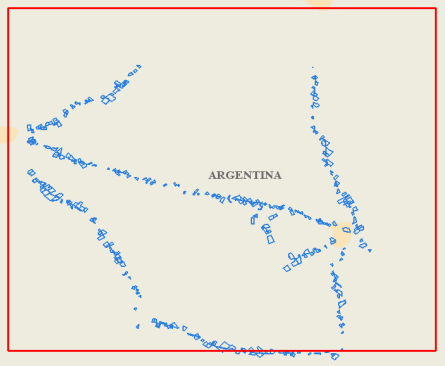


The map presented in Fig. 32 was created in VEGA-GEOGLAM with the supervised classification tool and the JECAM in-situ data as the training samples.

To view the Crop map for the whole Stavropol region:

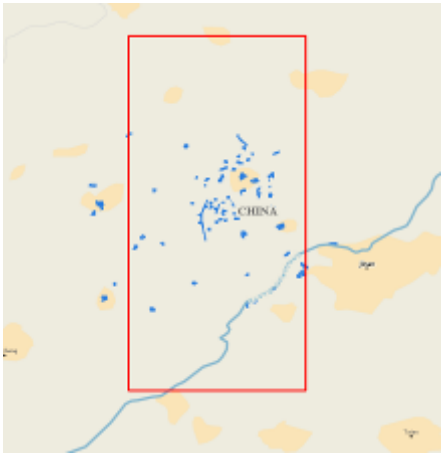
→ Navigate to **Russian SIGMA-JECAM test site (**Lat 45 Lon 43.2**);**
→ Go to **Fields vegetation state analysis;**
→ Go to **Agricultural maps;**
→ In **Local** select **Crop types for 2014 year.**

Figure 32: Crop map for the Stavropol region, 2014.



The Argentinean site (100-km by 90-km) is located in the Rolling Pampas, a sub-region of the Pampas with gentle slopes and rivers. Soils are mostly mollisols with a deep surface layer of high organic matter content. The climate is humid temperate with a homogenous precipitation regime and an annual mean of about 1000 mm. The main grain crops are soybean, maize and wheat. Agriculture is developed under no-till systems and mostly without irrigation. Typical field size is 20-ha but there is a high variability in plot size. Part of the land is also dedicated to forage including pastures and grasslands.

In Brazil, the site (80-km by 95-km) is located in the state of São Paulo close to the city of Itatinga. The climate is humid tropical with a mean temperature of 19°C and precipitations of 1390 mm measured in the past 20 years at the nearby Itatinga Experimental Station of the University of São Paulo. Temperatures and precipitations are lower from June to September, with temperature below 5°C several days each year. The land cover is dominated by cropland, pastures, planted and natural forests and water bodies. Annual crops are dominated by soybean and maize, with two cultivation cycles per year in monoculture or successions. Some of the fields are irrigated with pivot. Sugarcane, which is perennial but has an annual harvesting cycle, is also largely planted in this area. Permanent pastures and grasslands are present in the East of the area, and show an annual production cycle directly linked with the climate. Forest plantations, mainly eucalypts and pines, also share a large part of the area, and are harvested by clear-cuts.



The Chinese site (75-km by 60-km) is located near the city of Yucheng in the Northwest province of Shandong (Figure 1d). According to the long-term observation data from the Yucheng Integrated Agricultural Experimental Station, the area has a temperate, semi-arid monsoon climate, with mean annual temperature of 13.1°C and precipitations of 582-mm concentrated from late June to September. The land cover is dominated by cropland, forest and urban areas, with smaller areas of water and grassland. The dominant crop rotation starts typically with winter wheat followed by summer maize. Summer maize is sown in mid-June and harvested at the end of September to early October. The annual cycle is then repeated (Meng et al., 2013). Winter wheat is sown in early October and harvested in early or mid-June the following year. Typical field size is 0.2 and 0.8-ha at the site. Overall, the JECAM in Shandong province is representative of the North China Plain farming practices.

The test site in Ukraine (150-km by 110-km) is located in the region of the Kyiv oblast (latitude +50.0° and longitude +30.2°) (Shelestov2013, Kussul2014) (Figure 1f). The climate in the region is humid continental with approximately 709 mm of annual precipitations Land cover classes are quite heterogeneous including croplands, forests, grassland, rivers, lakes and wetlands. Forests and grasslands dominate its Northern part, while the central and Southern parts are agriculture intensive areas. The crop calendar is September-July for winter crops, and April-October for spring and summer crops. Dominant crop types include maize (25.1% of total cropland area in 2013), winter wheat (16.1%), soybeans (12.6%), vegetables (10.3%), sunflower (9.3%), spring barley (6.8%), winter rapeseed (4.0%), and sugar beet (1.3%). Fields in the region are quite large (except family gardens) with a size ranging up to 250 ha.

Field monitoring tools

Field is a monitoring unit in VEGA-GEOGLAM.
For every field (the defined borders of the object) the system automatically gathers and calculates EO data, meteorological data, NDVI and its deviation from the multiannual norm and other.

Field (user defined objects) creation

There are two options to create your objects (define borders of the fields to analyze) to monitor in VEGA-GEOGLAM:

1) Manually – through the Drawing and Passport of the Field tools;
2) Automatically – via Administrators. Use this option when you need to export a lot field borders from existing .shp file. Write to vega@smis.iki.rssi.ru, attach and describe your dataset, VEGA-GEOGLAM administrator will help you to load it to the VEGA-GEOGLAM interface.

To create a field manually:

→ Navigate to your AOI;
→ Select an image from **Satellite data** (or use DigitalGlobe Maps as a base map) and zoom in to the object you want to draw;

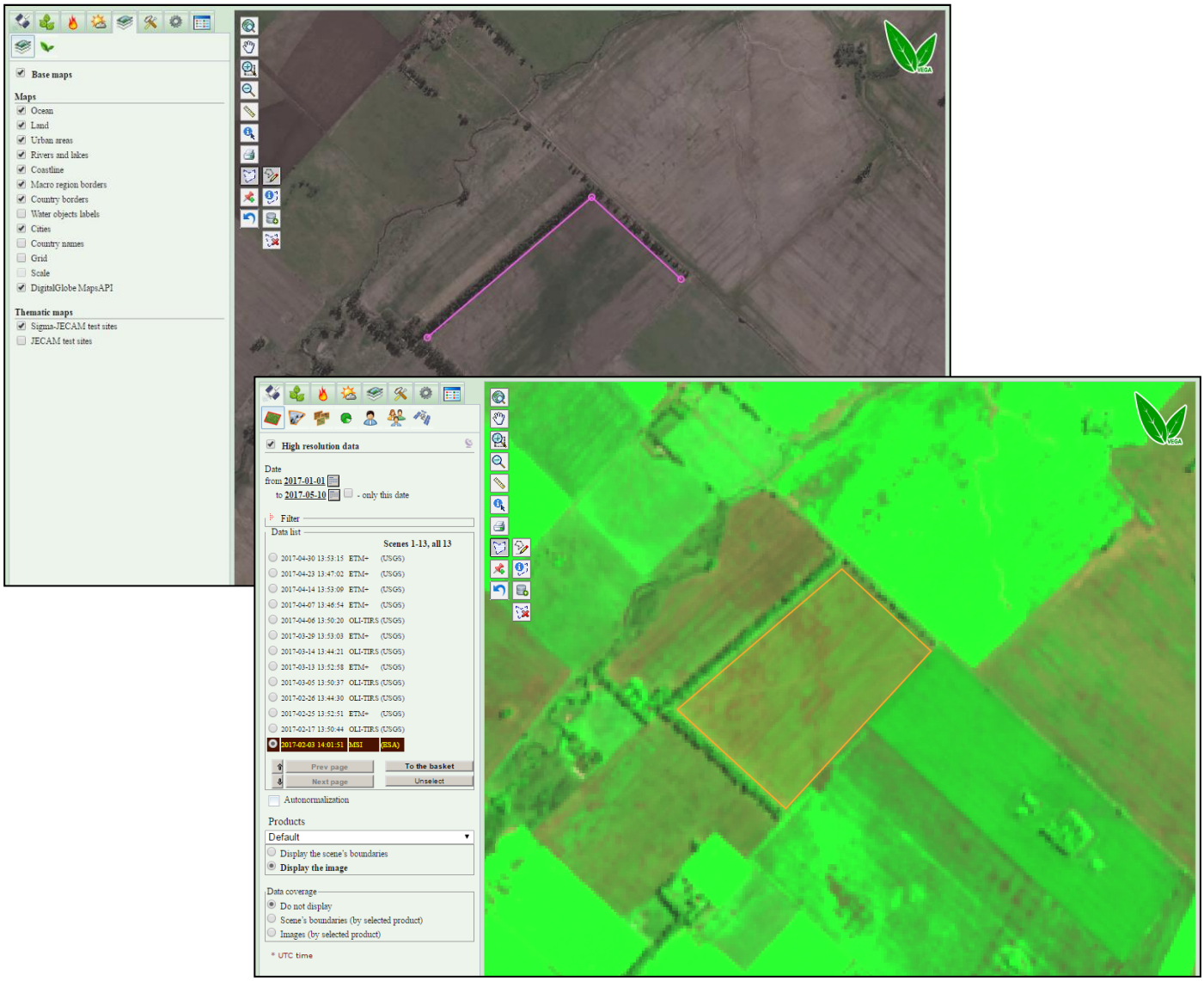


Figure 33: Field borders drawing

→ Select **Polygon** in the Toolbar, then **Polygon Draw** ;
→ Using mouse draw the field create a closed polygon. To finish polygon drawing you should locked first and the last vertexes with one click. If you need to delete object, use **Delete** .

→Select **Add polygon to DB** and save the field in the database: specify Field ID, Field description, usage type. The system confirms creation of a new field;

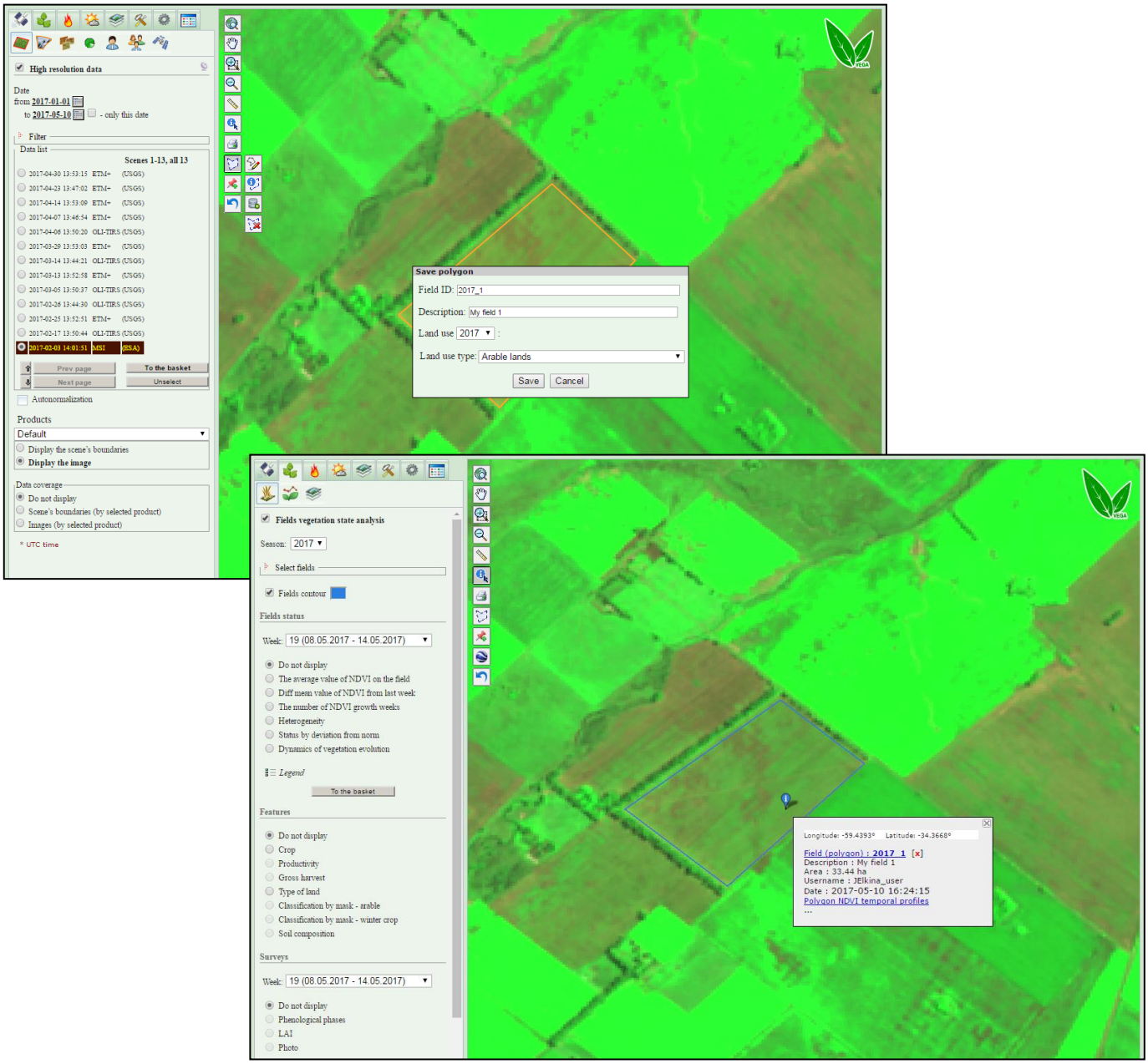


Figure 34: Field borders saving in the Database

→ To see the created field go to **Agriculture data** → **Fields vegetation state analysis** → in **Fields** block Turn on the **Field Contours**;

→ Use **Query** to open the **Field Passport**: t the pop-up window click on the Field name link.
Field passport opens in a new browser window allowing you to input the additional information about the field. Add crop type information to color fields on the map according to the crop type.

Field passport

Additional information about the fields is stored in the Field Passport.

A user can enter following information for the field (field borders):

- General description;
- Type of land;
- Crop type;
- Yield;
- Phenological stages.

Figure below illustrates the Field Passport elements:

1. General Field description: ID, name, area, country, region, district, date added and username;
2. Edit/save additional information;
3. Set Land type;
4. Set crop information;
5. NDVI (and the other parameters, if available) for the field for the current year. Click **analysis** to go to Graph Interface;
6. Field borders and coordinates

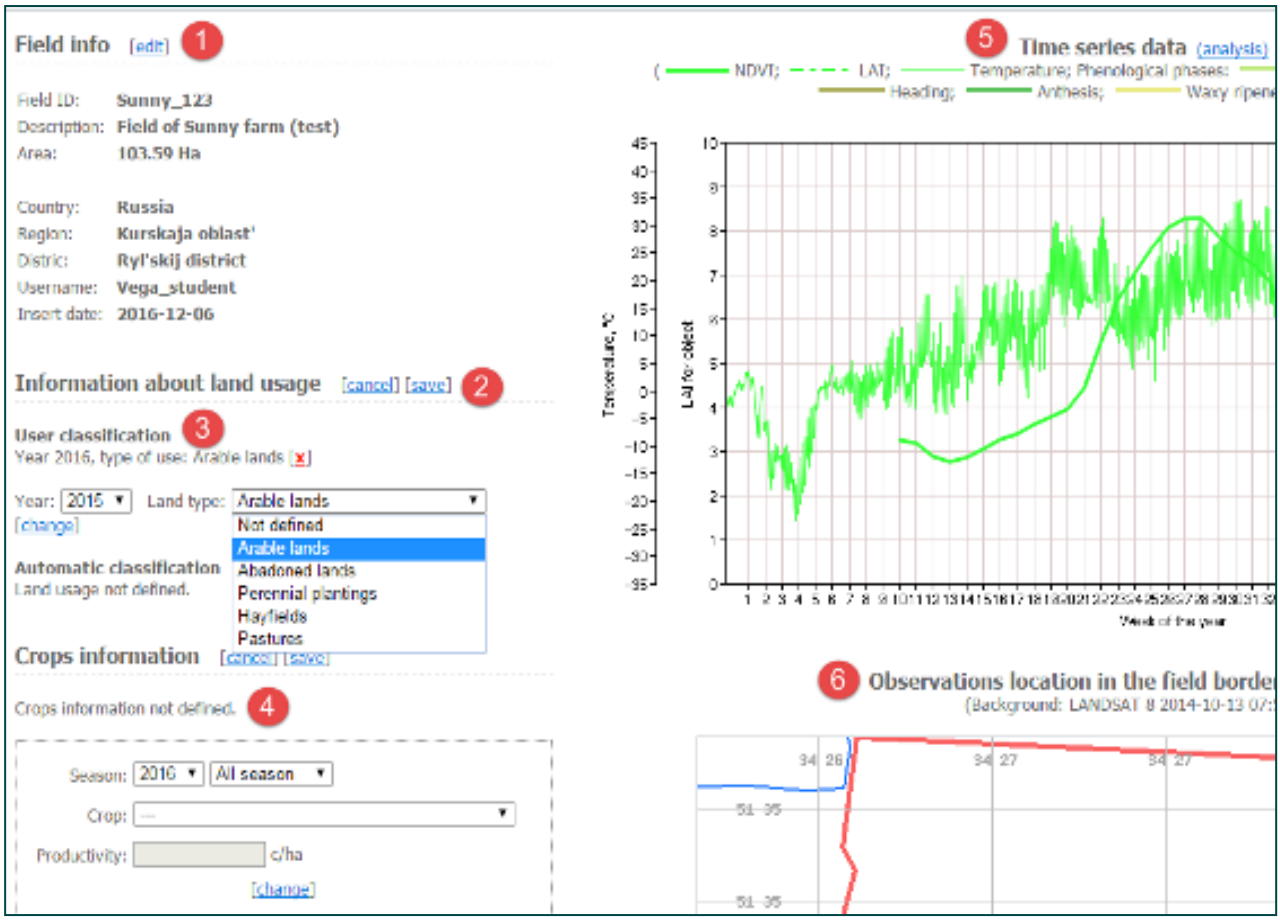


Figure 35: The Field Passport interface.

How to open and to fill the Field Passport:

→ Navigate to your AOI;
→ Go to **Agricultural data** → **Fields vegetation state analysis**;
→ Set **Season.** Turn on **Fields contours;**
→ Zoom in to field you want to edit;
→ In the Toolbar select **Query** and click on the field. You'll see an Information pop-up window;
→ Click on the field name (in a row **Field (polygon): field name**). It will open **Field Passport** in new browser window;

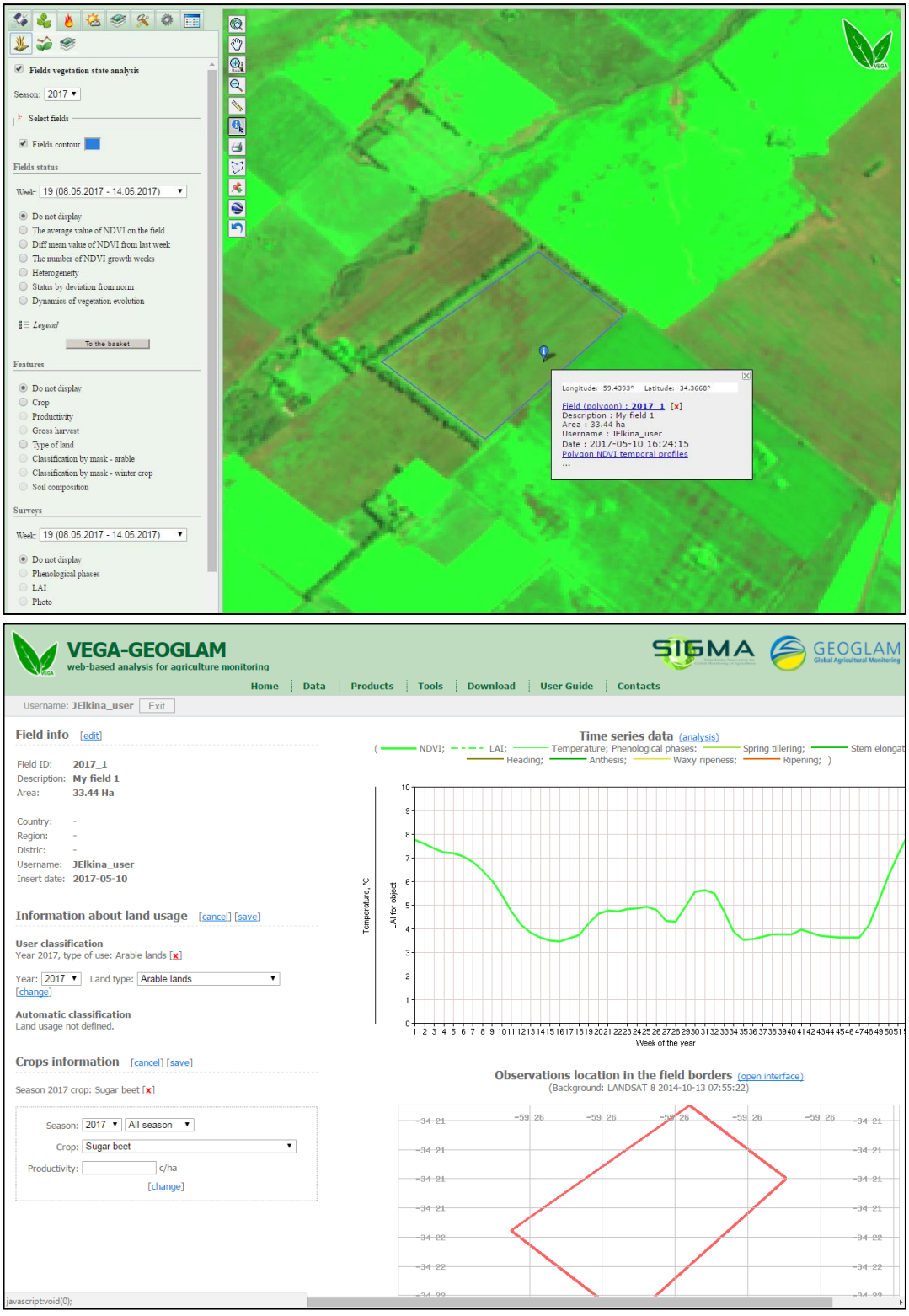


Figure 36: The Field Passport interface opens with Query tool

→ Explore and edit the Passport. Editable fields are marked with the **[edit]** links. After editing information click **save** to save your edits.

At **Fields vegetation state analysis** turn on the visualization for the additional information (fig.37) – for example, crop types information. There is a color legend for the most popular crops.

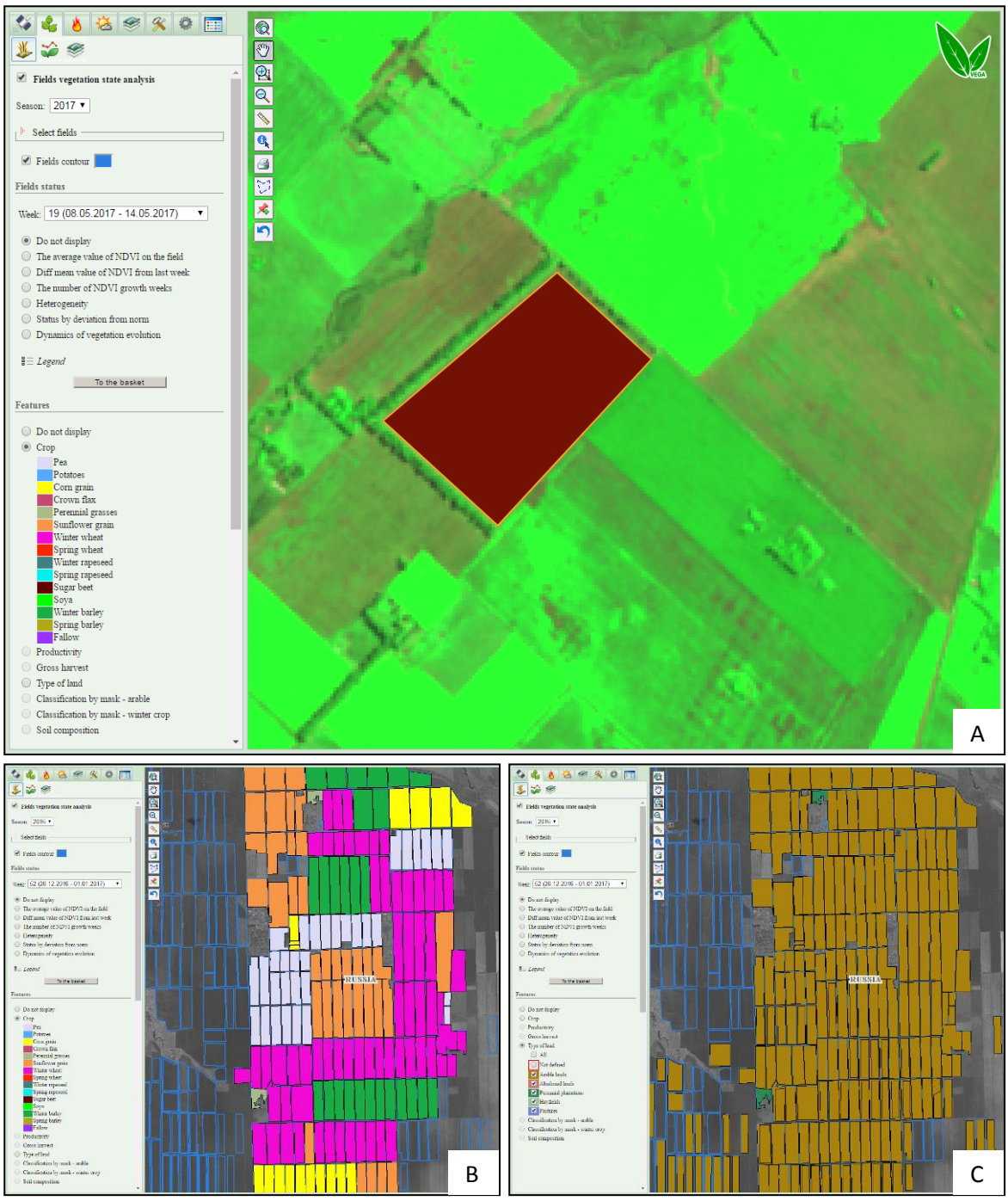


Figure 37: a) Information about the crop type of the field (Sugar beet, season 2017) was added to the Field Passport and then visualized at the map; b)Group of fields with the crop type data; c)Group of fields with the land usage data.

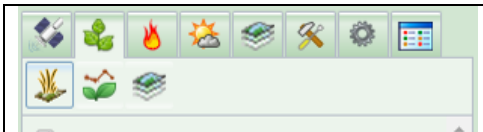
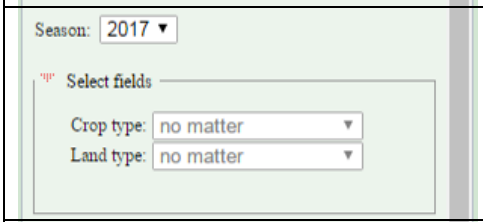
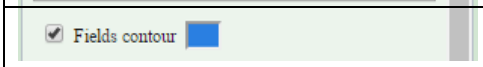
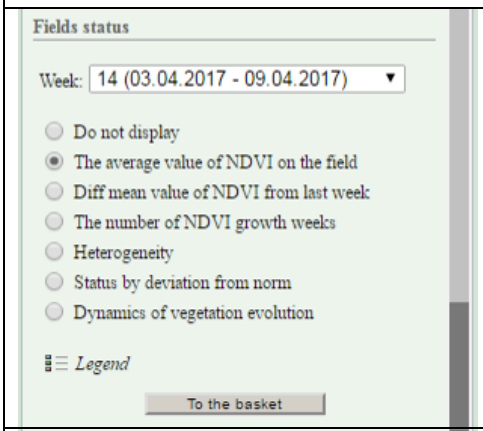
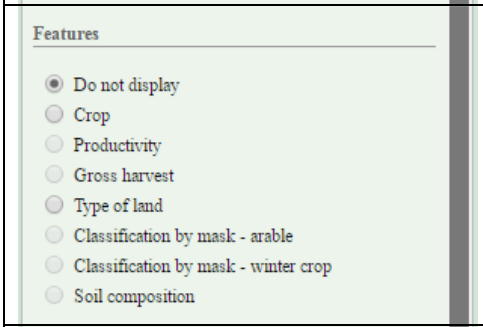
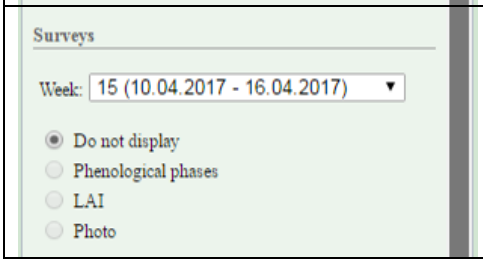
Agricultural data group of tab

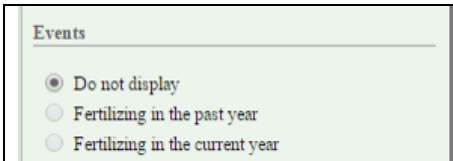
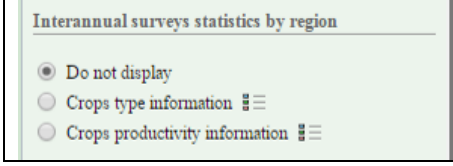
There is a special group of tabs to work with fields – **Agricultural data.**
The tabs are:

- Field vegetation state analysis - field management;
- Vegetation state analysis by district - crop status assessment at regional level;
- Agricultural maps - useful thematic maps.

Field vegetation state analysis

Tab allows to visualize field boundaries and crop types maps based on objects' related attributes.

	Turn on/off the Field vegetation state analysis tab
	Select **Season** (the year) Select **Crop type** and **Land type** of the fields
	Turn on **Field contour** (borders) displaying Blue color set as default
	Cartograms. Choose the week and choose any of **Field status** maps to see the thematic maps based on NDVI. Read more about cartograms at the Cartograms chapter.
	**Features** Choose any parameter (attributive information) that was added to the Field Passport) for the field to be displayed on the map: Crop type, Productivity, Type of land and other.
	**Surveys** Choose the week and select type of in-situ survey. It will show on the map if there were any in-situ surveys (such as LAI measurements) at the fields.

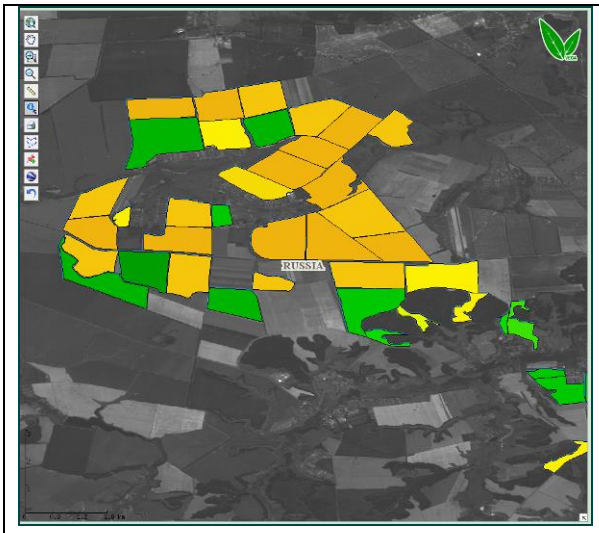
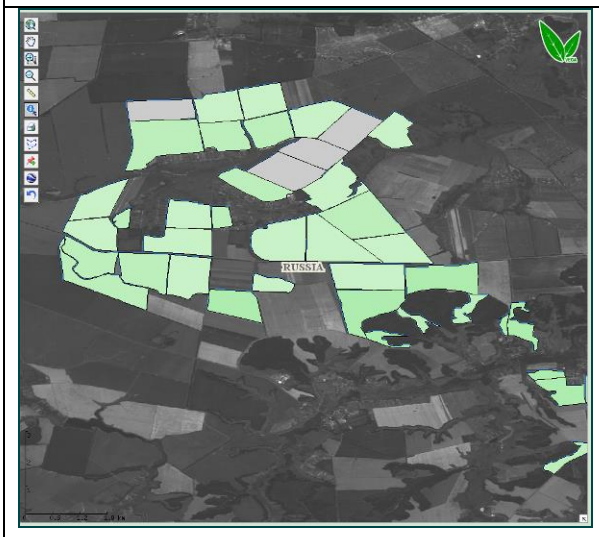
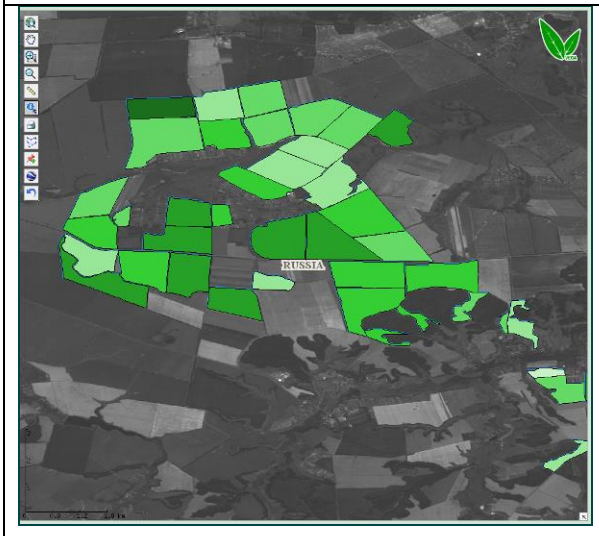
	**Events** Choose the type of event: current year or past year fertilizing. It will show on the map if there were fertilizing events.
	**Interannual survey statistic by region** Choose the type of information: Crop type or Crop productivity information. It shows how much attributive information there is in Vega for the fields for the each region.

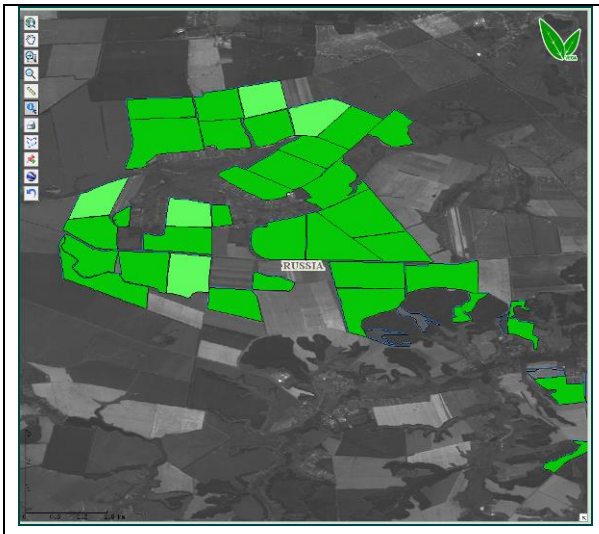
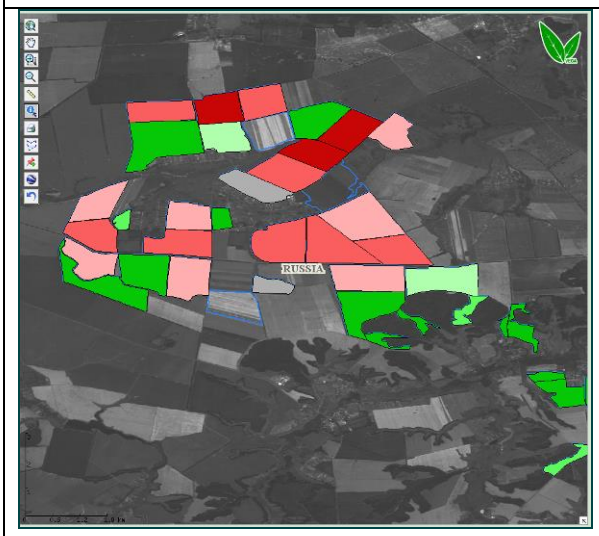
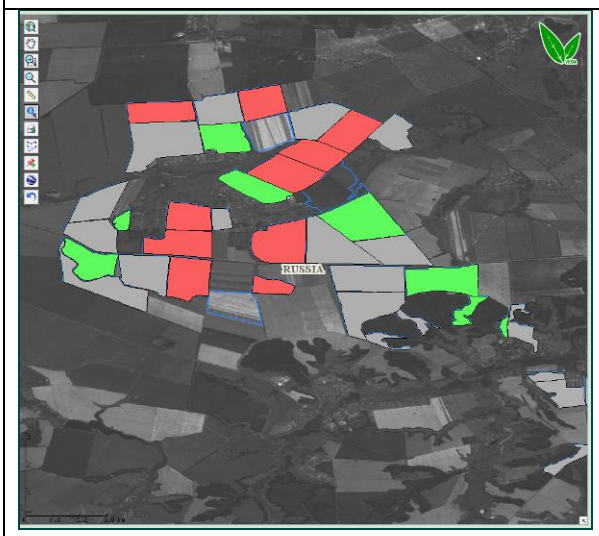
Field status cartograms

Cartograms are thematic maps based on weekly NDVI values for the fields that show the crop conditions over a given period. Cartograms show field status, which is useful for the crop development anomalies detection, for finding the most vulnerable spots and the yield assessment.

To turn on cartograms:

→ Navigate to your AOI;
→ Go to **Agricultural data** → **Fields vegetation state analysis;**
→ Set **Season;**
→ Turn on **Fields contours;**
→ Turn on any of the **Field status maps (cartograms).**

	The average value of NDVI on the field - shows the average weekly NDVI value for the field
	Diff mean value of NDVI from last week - shows the difference of the average NDVI value between the current and previous weeks on the field
	The number of NDVI growth weeks - shows amount of weeks when there is crop development detected on the field (it NDVI values increase or not)

	Heterogeneity map- shows how homogeneous in terms of NDVI a field is
	Status by deviation from norm - shows the deviation of NDVI for the field (in %) from the multiannual statistical mean NDVI value for the defined region and crop type
	Dynamics of vegetation evolution - shows the trend of deviation from the NDVI mean for each selected field

Vegetation status analysis by administrative districts

VEGA-GEOGLAM provides automatically calculated weekly NDVI values for arable lands in any region of Russia.

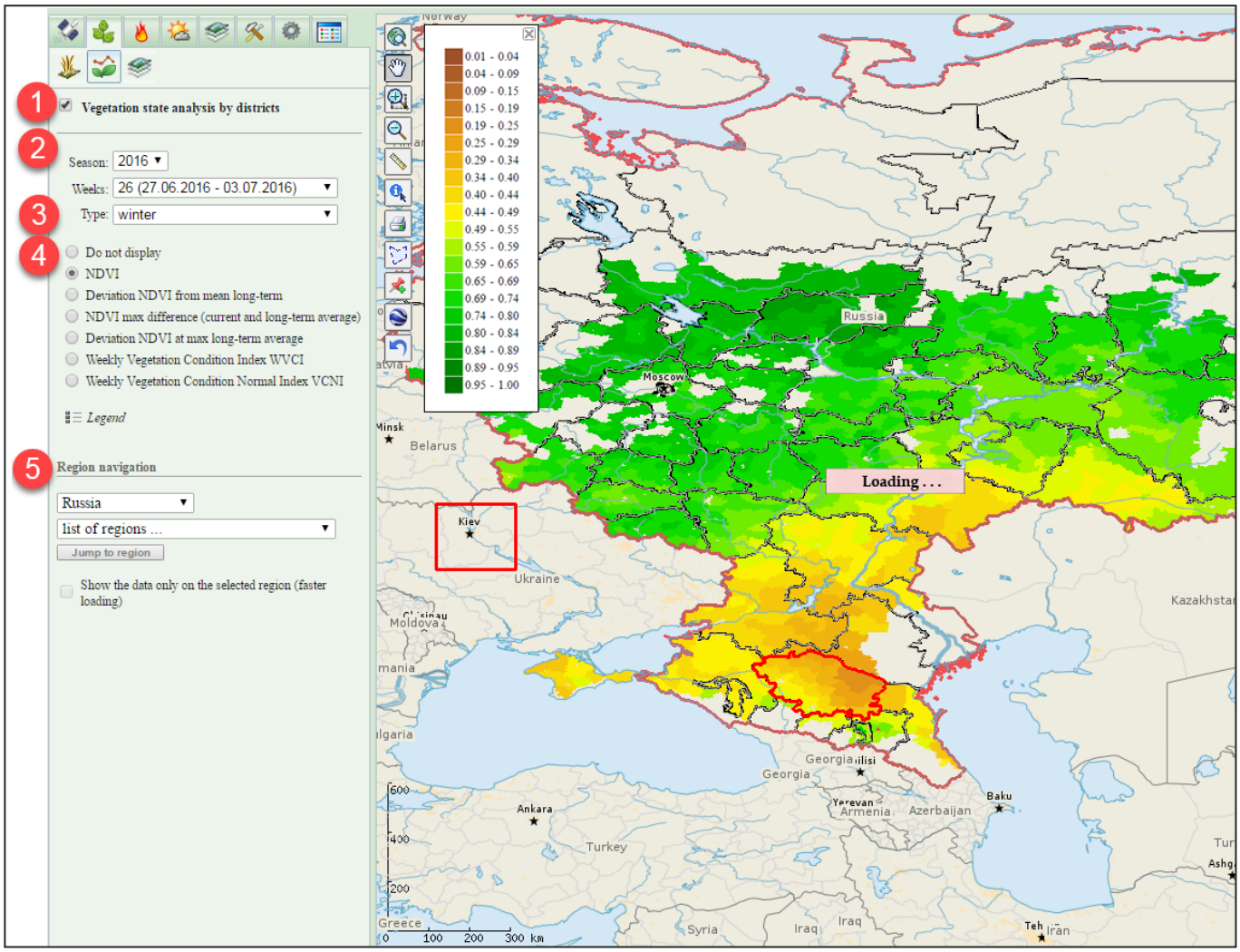
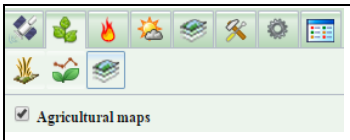


Figure 38: NDVI map for the Russian regions.

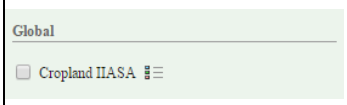
To get NDVI values and NDVI deviation maps for Russian regions:

1. Go to **Vegetation analysis** → **Vegetation state analysis by district;**
2. Select **Season** and week;
3. Select Type of crops (arable, winter, summer crop, forest, forest leaf, forest pine);
4. Select a map:
   - NDVI;
   - NDVI deviation from the multiannual norm;
   - NDVI max difference;
   - Deviation NDVI from max long-term average;
   - WVCI index;
   - VCNI index.
5. Navigate to the specific region.

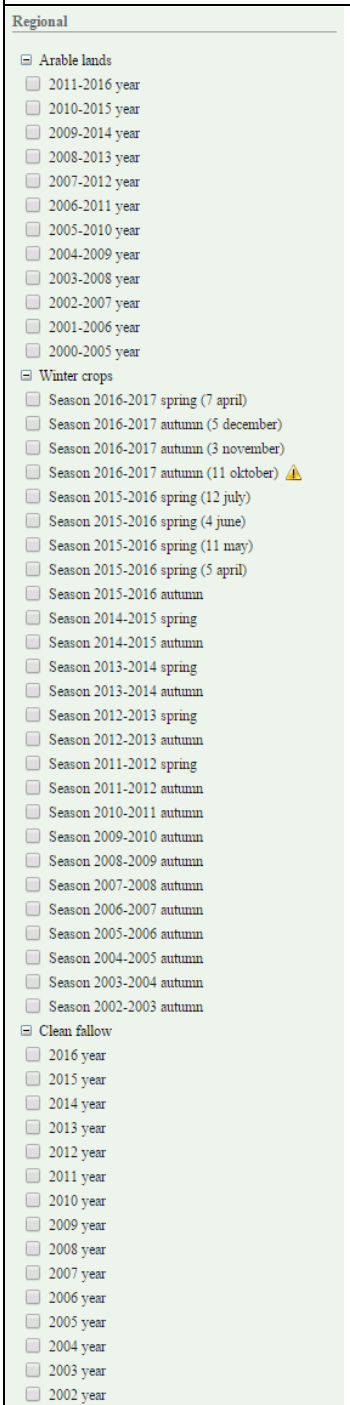
Agricultural maps



Turn on/off the Agricultural maps tab



Global maps: IIASA cropland map (2015)



Regional maps:

- arable lands maps (for every 5 years from 2000);
- winter crops maps (for every season from 2002);
- clean fallow maps (for every year from 2002);

Figure 39: Arable lands map for 2011-2016 years

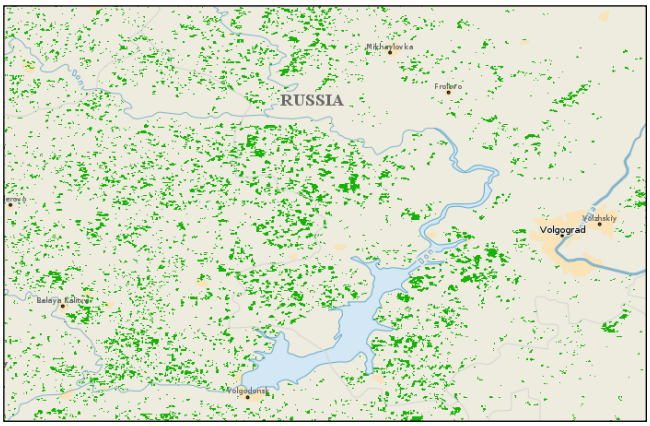


Figure 40: Winter crops in the Southern Russian regions, season 2016-2017

Local maps: maps for Stavropol region (Russian SIGMA-JECAM test site)

Time series tools. NDVI time series

There is a **Graph Interface** in VEGA-GEOGLAM to work with vegetation indices and meteorological data time series. NDVI archive is one of the most valuable components of VEGA-GEOGLAM. NDVI - the normalized difference vegetation index - commonly used vegetation indice. NDVI is describing vegetation (relative biomass) by showing the difference between near-infrared (which is strongly reflected by vegetation) and red light (which is absorbed by vegetation).

NDVI = (NIR - red) \ (NIR + red)
Where NIR is near-infrared reflectance, red is red reflectance. NDVI values range from -1 to 1.

This index can show us plant "greenness" and the higher the value of the NDVI index is– the more relative biomass there is, and we consider that a plant is healthier.

You can use NDVI maps, NDVI time series, Crops status maps or create your NDVI map using imagery with NIR and red bands in VEGA-GEOGLAM. VEGA automatically calculates NDVI values for the user defined objects - the fields. In addition, VEGA aggregates NDVI values on a regional level (fig.41).

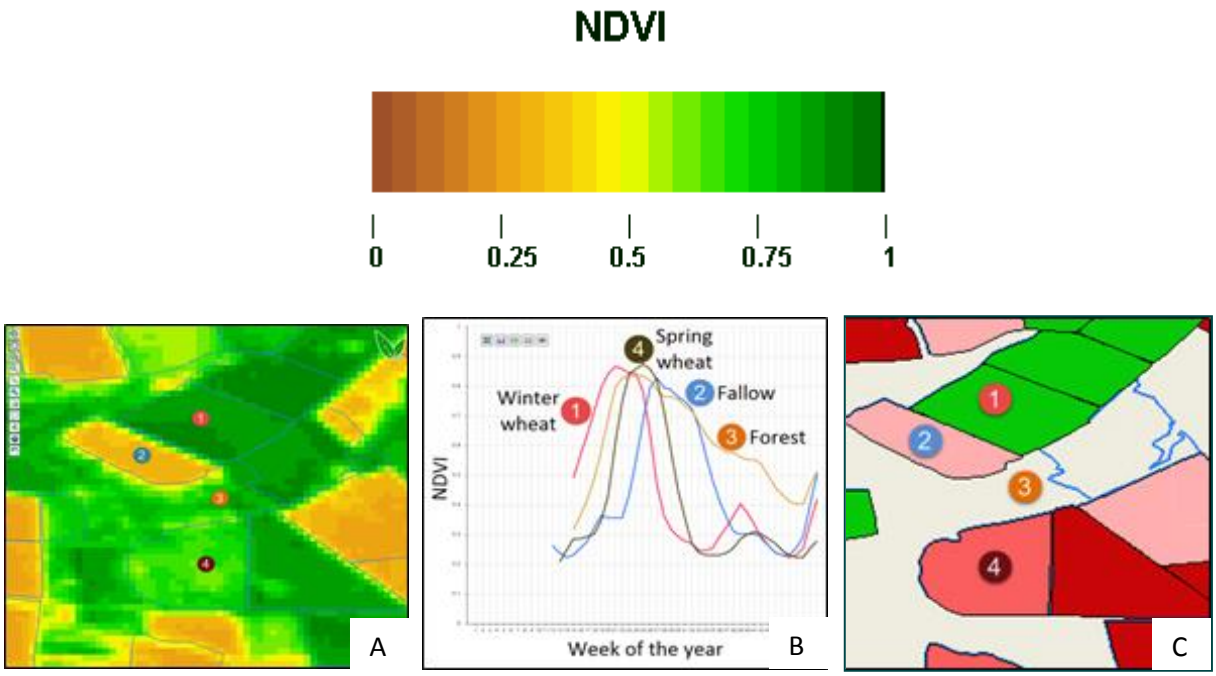


Figure 41:
a) NDVI Landsat derived map (satellite image product); b) NDVI time-series for the selected objects; c) Crop status map for the group of fields based on NDVI values and comparison with a mean.

There are several options to get NDVI map for the chosen area in VEGA-GEOGLAM:

- NDVI map at a given date (satellite image product);
- Weekly average NDVI map (MODIS derived cloud-free composite);
- Indices calculation (calculate NDVI for any satellite image manually).
- To see NDVI graph for the field(s), use Graph interface.

Time series analysis allows us to solve a broad variety of agricultural monitoring tasks:

- To assess the field usage history analysis for any period of time from 2000 year;
- Crop development trend analysis;
- Current to standard NDVI comparison and detection of anomalies in crop development (standard is supposed as any user defined norm or the multiyear statistical mean NDVI value);
- Crop development condition comparison with other fields and with other years;
- Field vegetation development trend comparison;
- Field usage control through the season;
- Land usage assessment for the targeted purpose;
- Agricultural work control and assessment.

NDVI graph for the field

To open Graph Interface with NDVI and meteorological data time series:

→ Navigate to your AOI;
→ Go to **Fields vegetation state analysis;**
→ Select Season, Select fields, turn on Fields contour;
→ Zoom in to your field;
→ Select **Query** and click on the field.
You'll see an Information pop-up window with the field description.
→Click on the field name (in a row **Field (polygon): field name**). It will open **Field Passport** in new browser window. Then in **Field Passport** click **Time series data (analysis)**.
or
→ Click on **Polygon NDVI temporal profiles**. It will open Graph Interface in new window.

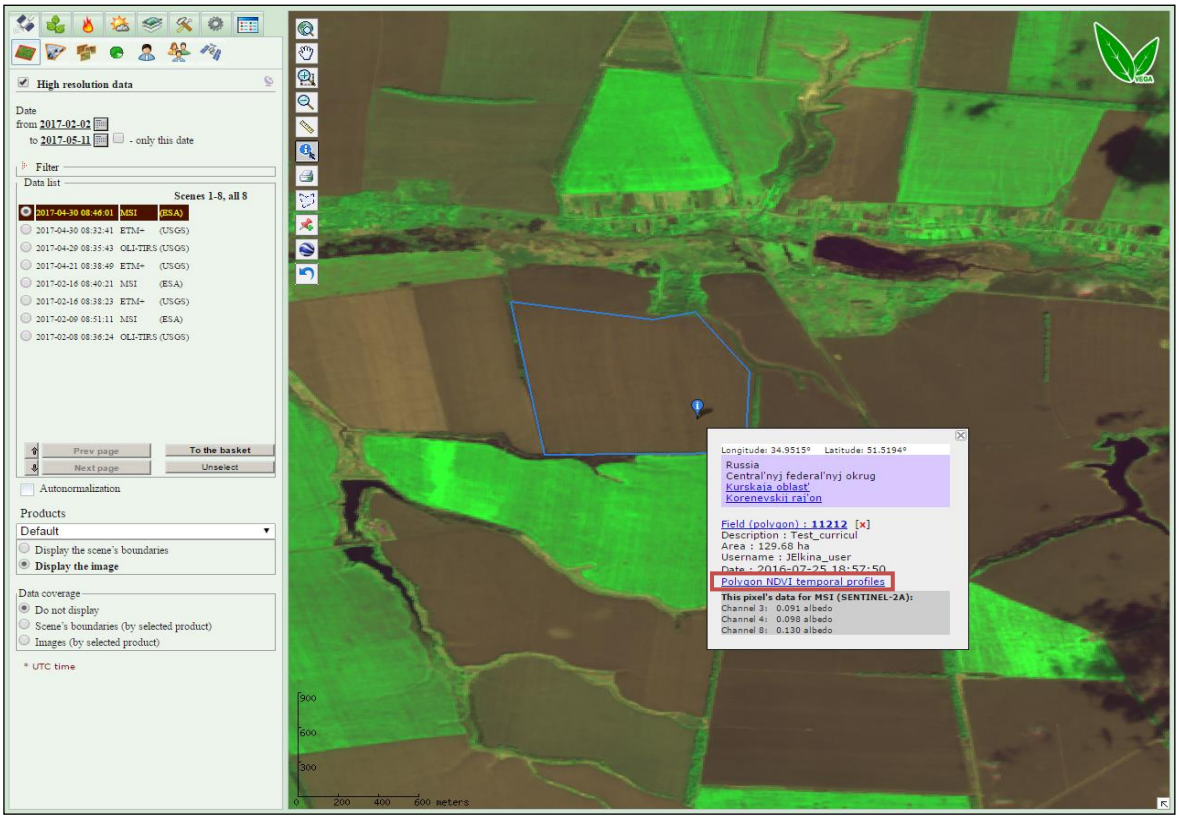


Figure 42: Field information window.

At **Graph interface** a user can open time series for the objects for the defined years and defined parameters:

1- Group of tabs (Object, Region, Norm, Parameters, Legend)
2- Selected object (field)
3- Displayed parameter (NDVI, PSPI, meteorological parameters)
4- Year(s)
5- Toolbar (Zoom out, Save as .png, Save as .csv, Show point values buttons)
6- Graph
7- Selected parameter axis (values)
8- Week of the year axis

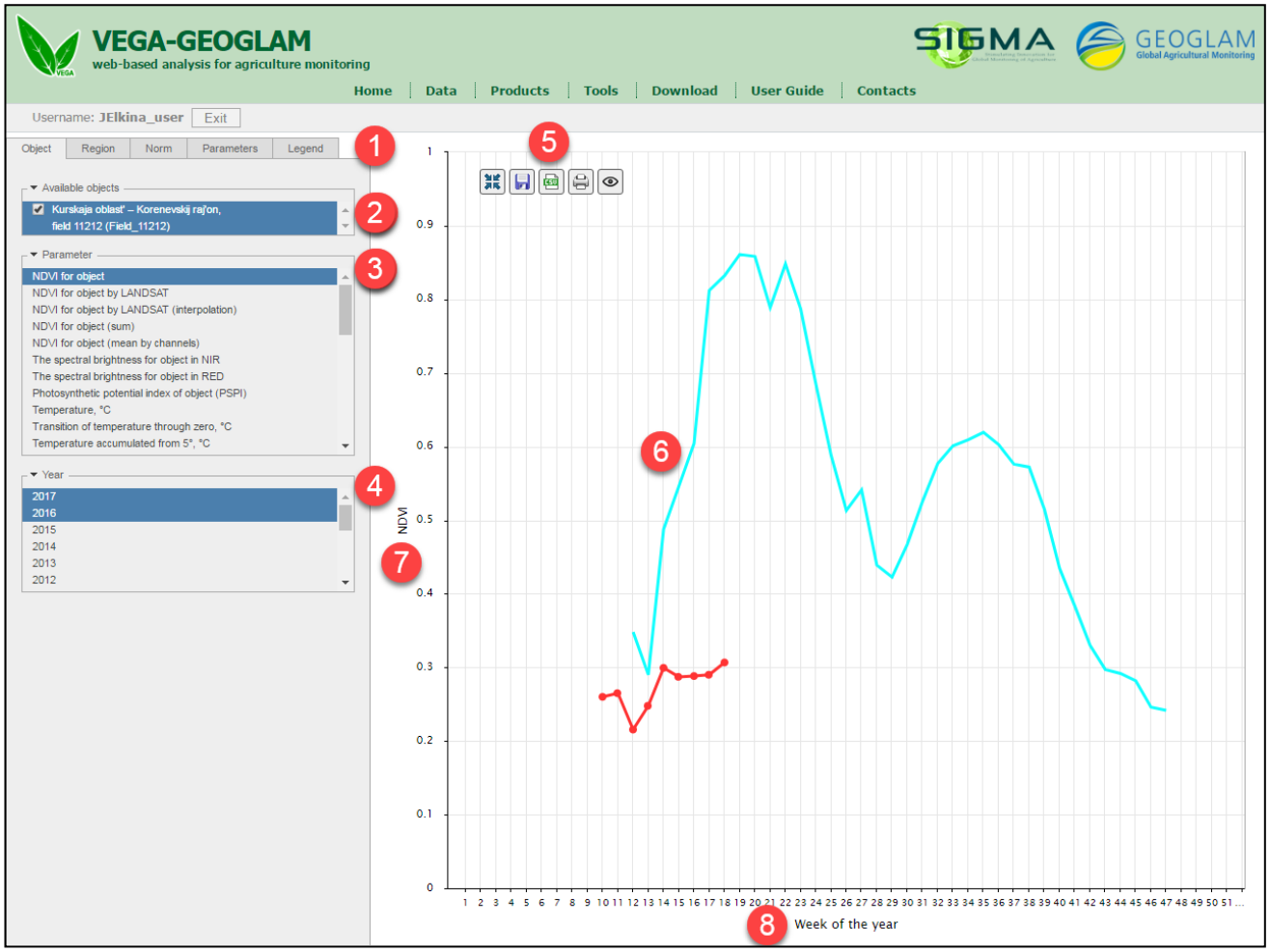


Figure 43: Each point at a graph represents a weekly average value (NDVI).

Graph Interface tabs are:
Object- NDVI and meteorological time series for the object (field);
Region – Actual and automatically calculated multiannual values aggregated by region;
Norm – Set the norm to compare and assess current vegetation development on the field;
Parameters – use this tab to define displayed parameters for regions (in Region tab);
Legend – change style and color of the graphs.

To view values at the points of a graph:

→ Click on **Show/hide points value** ((fig.44, 1) ;
Turn on **Show/hide point's value** and explore the NDVI graphs. For NDVI graph each point is the mean weekly value of NDVI for the field.

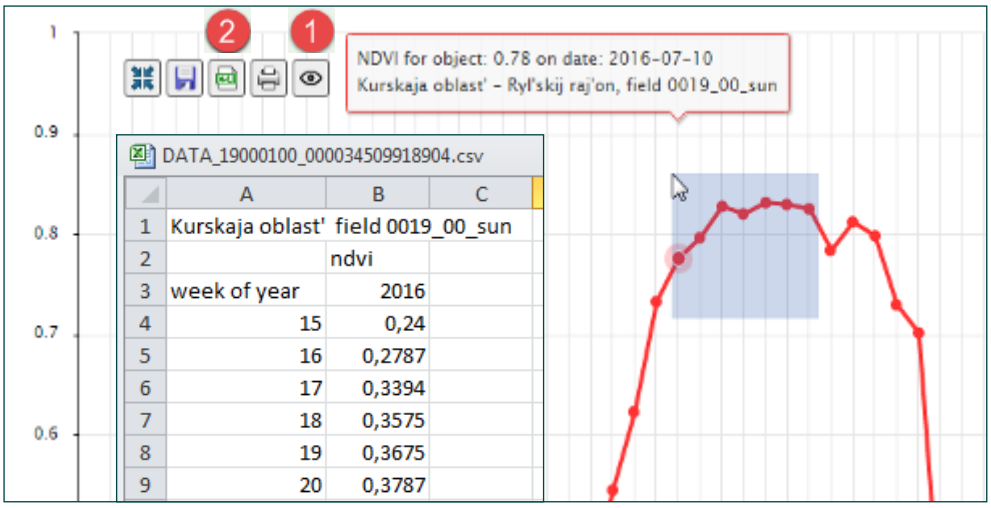


Figure 44: NDVI graph and NDVI values.

Draw a square on a part of the graph using pointer to zoom in. To return to full extent click **Show full-size** .

To download the set of values:
→ Click on **Export Data (CSV)** (fig.44, 2). You can open and work with this file in Microsoft Excel or other editor.

To change the graph style:

→ Open the **Legend tab;**
→ in the list of objects click on the object which style you want to change;
→ **Style settings** window Opens;
→ here you can choose **Color, Width** and **Style** of the line.

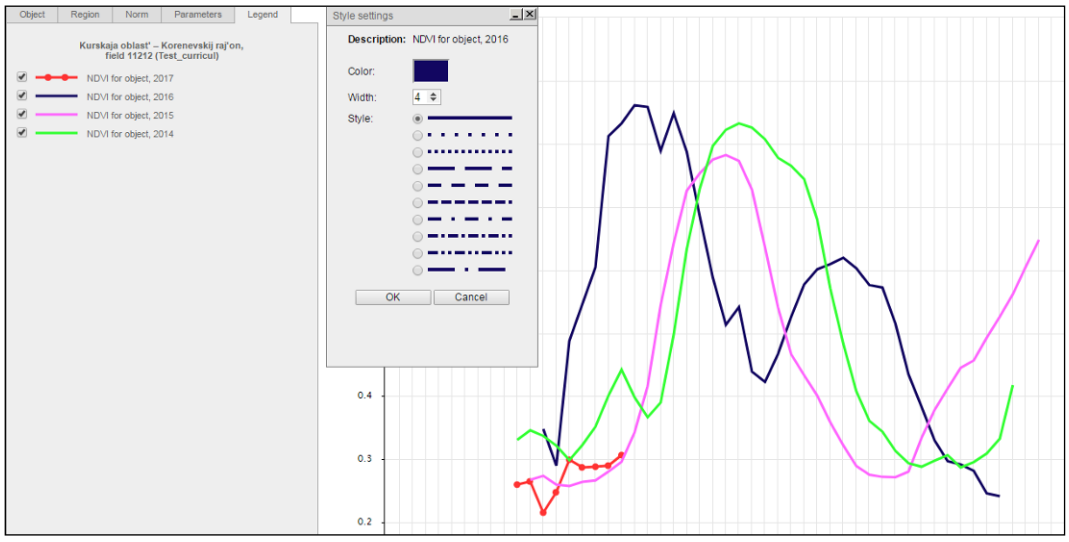


Figure 45: Changing the style of the NDVI grahp

Field comparison on NDVI

A user can see vegetation growth dynamics at the fields and compare the NDVI graphs with the:

1) Multiannual NDVI mean for the specified crop type and region (norm);
2) The other year (NDVI for the same object but for the other year);
3) The other field(s).

1. Comparison with the norm

It is possible to calculate current NDVI value for the winter and spring crops separately within the borders of defined polygons (fields) and to compare it with the average trend. As a trend, or norm, multiannual NDVI value, calculated from 2001 to current year, is assumed. As a mask for arable and non-arable lands IKI created maps are used. Comparison with the norm is a basis of anomaly detection in the crop development.

To compare vegetation development on a field with multiannual average trend for defined area and crop:

→ Open **Graph Interface** for the selected field**;**
→ At **Graph Interface** go to **Region tab;**
→ Select the region, then **NDVI average (winter crops)** as a parameter to display and **Multiyear parameter** to see the average value calculated from historical archive.

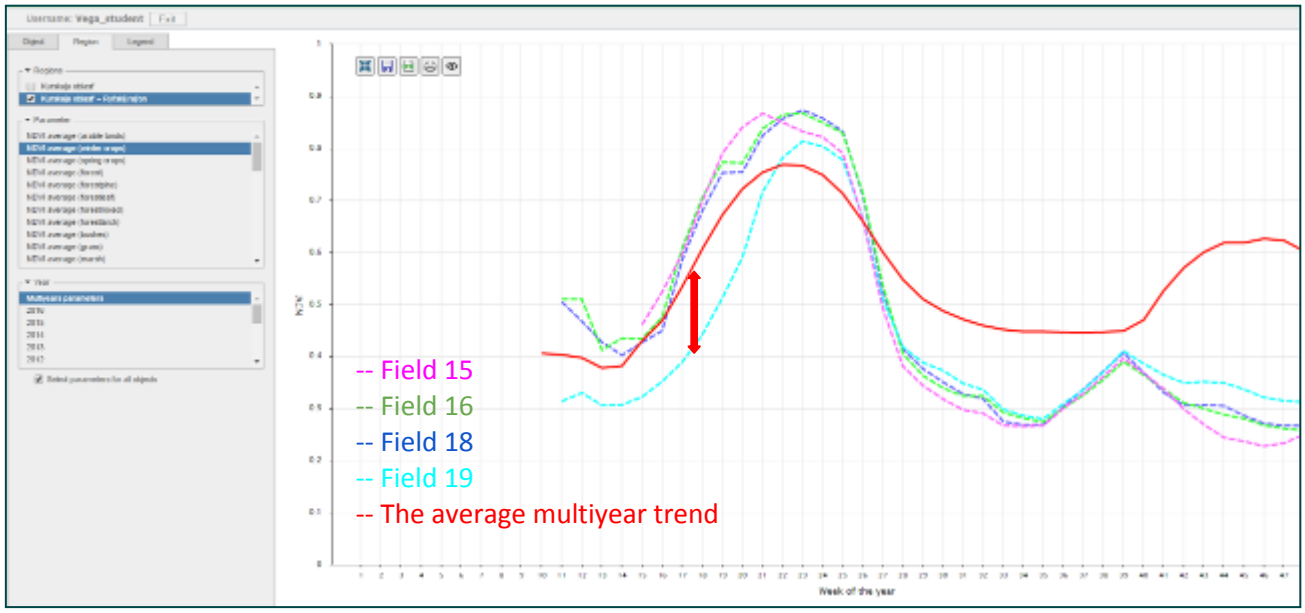


Figure 46: The graph shows that 15, 16, 18 fields are started to grow in line with the trend, while 19 field has a deviation.

To see the field status by deviation from the standard:

→ At **Graph Interface** go to **Norm;**
→Set the norm as **Average annual NDVI in district** (for the winter crops, spring crops or arable lands);
→Click **Set norm;**
→The graph will be colored according to the legend (from very good to very bad), showing the current status as deviation from the multiyear norm.

You may set a custom standard by choosing the year-analog or any previously saved norm.

2. Comparison with the other year

To compare the crop conditions of the one field for the two different years:

→ Open **Graph Interface** for the selected field**;**
→ Select the displaying **Parameter**(s) (at fig. 47 NDVI and Maximum temperatures were chosen);
→ At **Objects** tab select several years;
→ Go to **Legend** and change the NDVI graph style to make it more visible (at fig.47 2010 NDVI graph width is 3);
→ Return to **Objects;**
→ Turn on **Show/hide points value** and explore the NDVI graphs. Each point is the mean weekly value of NDVI for the field;
→ At **Objects** select**;**
→ Turn on **Show/hide points value** and explore the values.

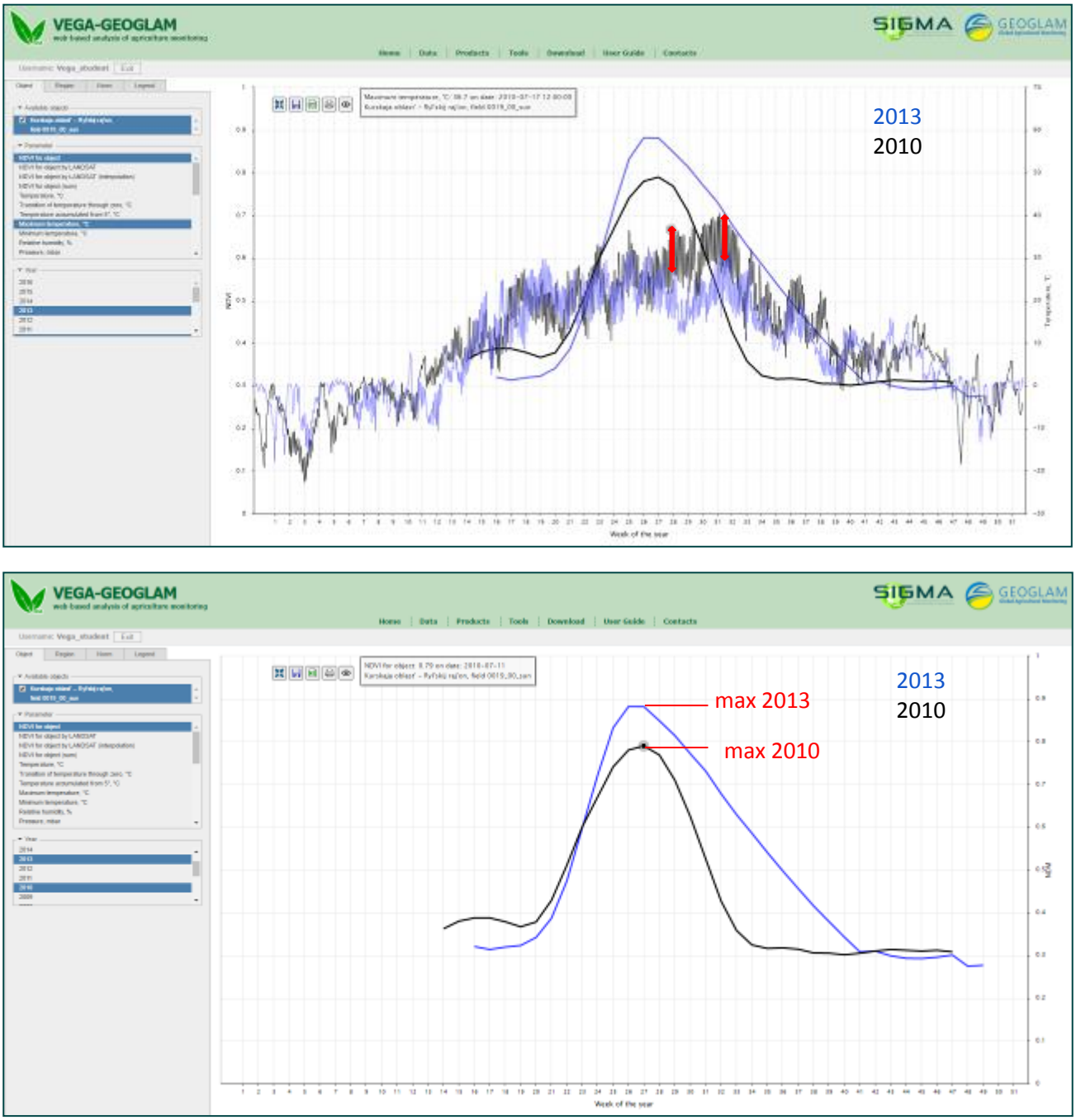


Figure 47: An analysis of crop development on the one corn field for two different years shows that the reasons of unsatisfying crop conditions in 2010 year were very high temperature and poor hydration in the summer season.

3. Comparison with the other field(s)

To compare several fields with each other a user should create a Group of fields, mark all the fields to compare, add them to the Group and open the graph interface for the group of the fields.

There is a special tab for group creation - **Point Objects** (read more at the Point Objects chapter). To add fields to comparison:

→ Go to **Data Analysis** → **Point objects;**

→ Click **Add new Group** and set **Name, Description** and **Color** for the points. You can create several groups.

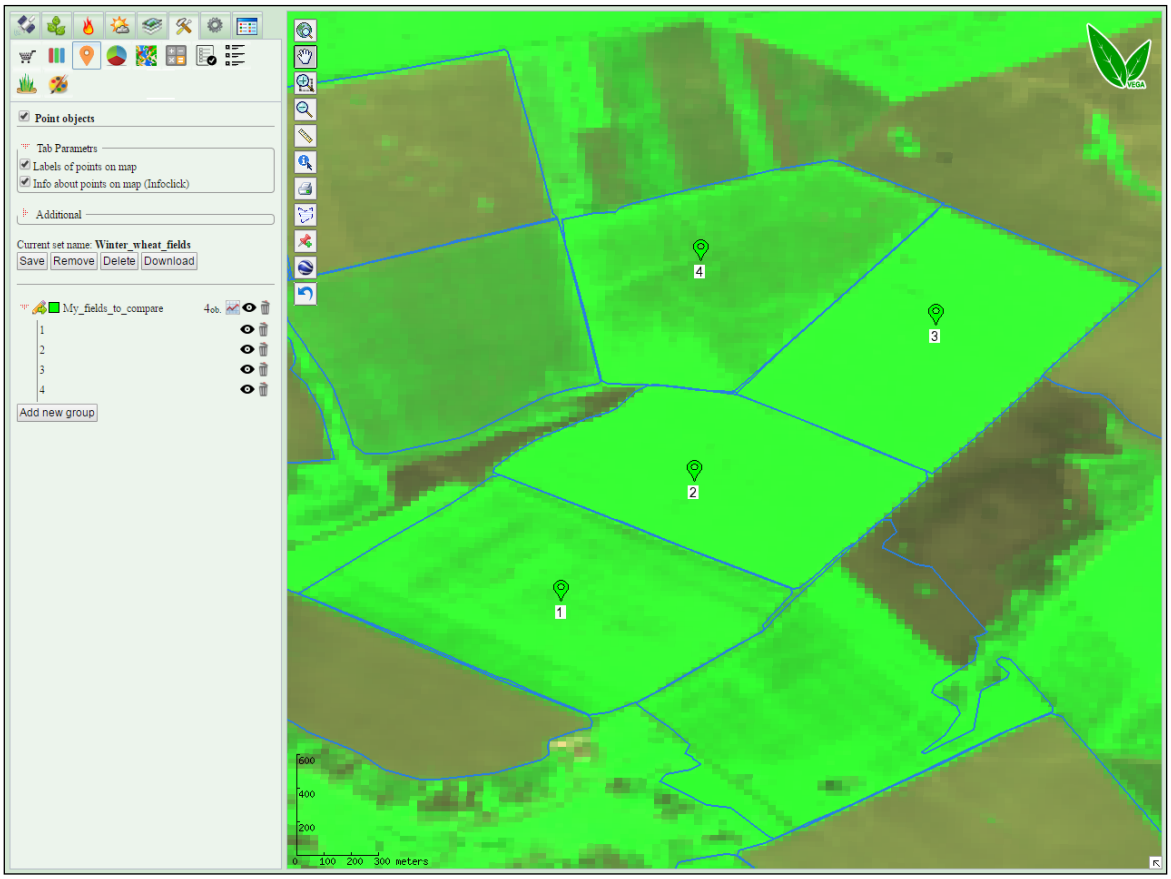


Figure 48: Points on the map.

→ Add points (fields) to the group using **Add Point object** by clicking on the map. Edit names of the points and the group of points with edit tool;

→ Click **Open graphics plotting menu for all points in this group**

→ Select **Fields temporal profile.**

Graph Interface opens in new window. Here you can work with NDVI and meteorological parameters time series for the group of the selected fields and compare them with each other.

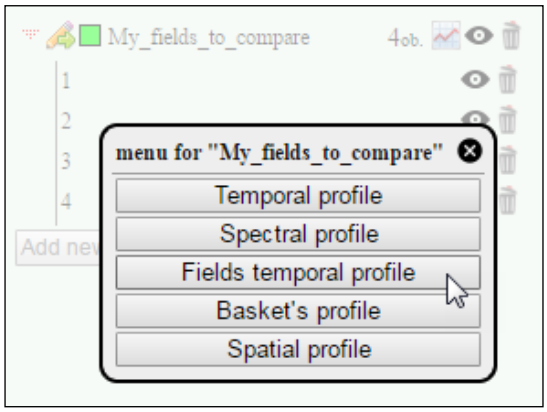


Figure 49: Group of points menu.

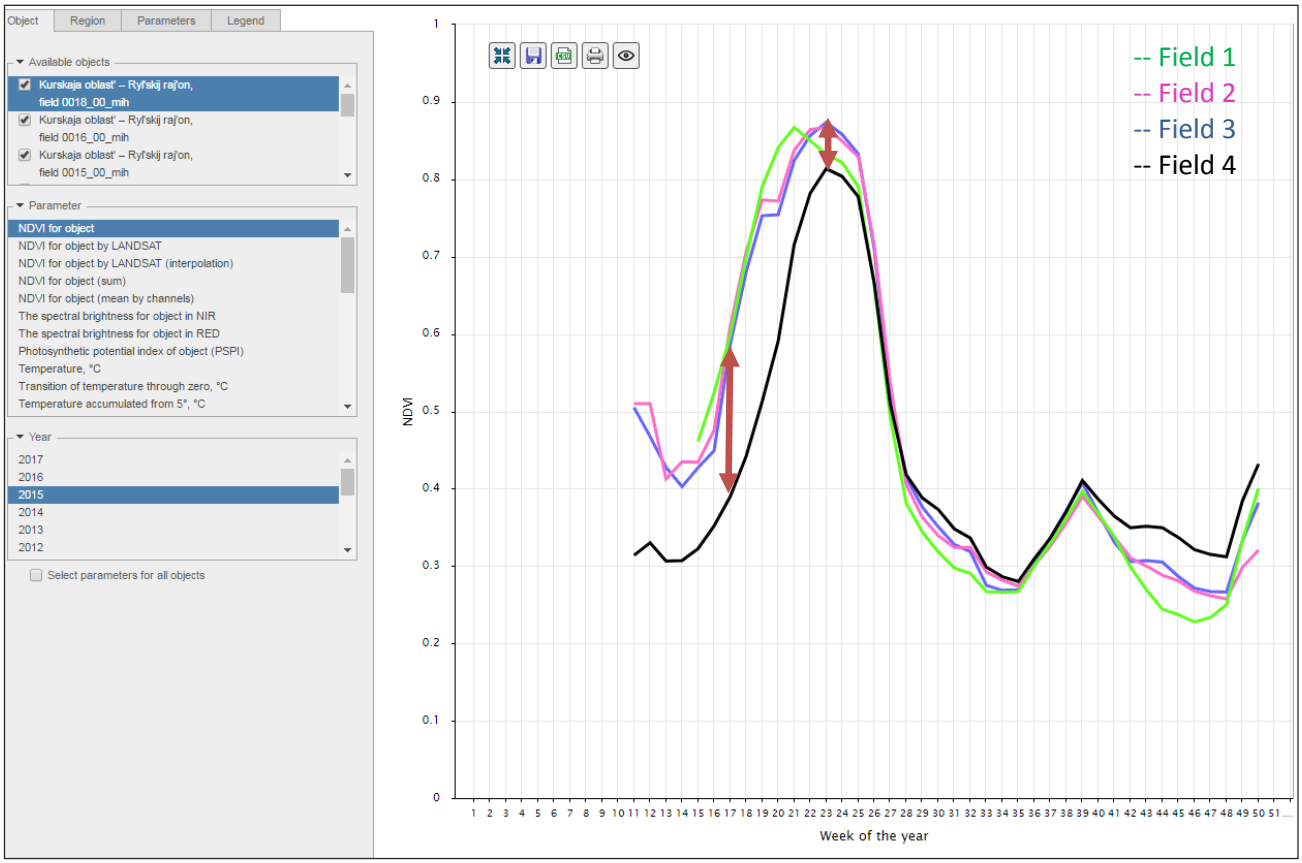


Figure 50: Winter wheat field NDVI comparison.

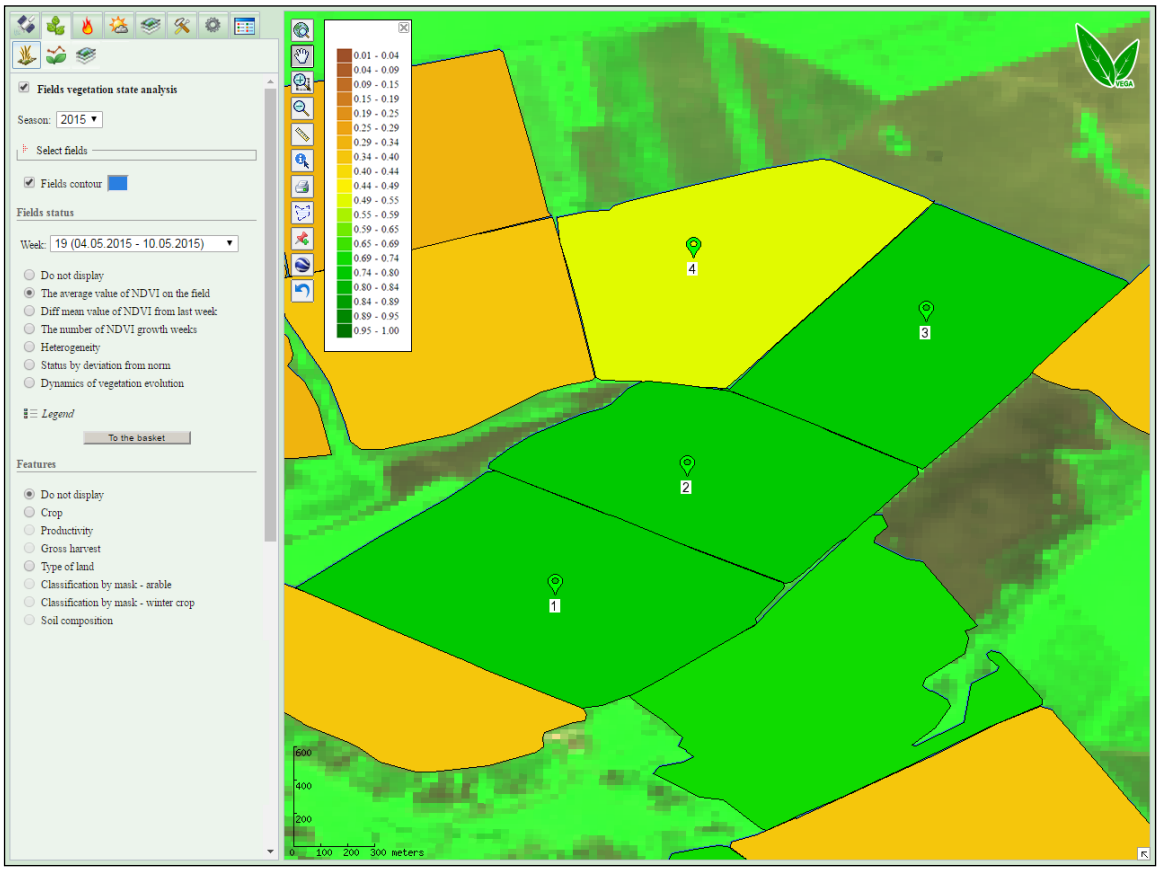


Figure 51: Weekly NDVI map, that shows average NDVI value for the field, shows that 4th field has a lower NDVI values in comparison with the 1st, 2nsd, 3d fields. All these fields are fields with winter wheat, and for the beginning of May the situation with such low biomass at the 4th field seems abnormal. This may be an indicator of some problems that can lead to the low yield.

NDVI graph for the region

To view and download NDVI time series for Russian regions:

→ Open **Graph Interface** for any field in the region;
→ Go to **Region tab**;
→ Select the **Region**, **NDVI** (and/or other parameters)
→ Select the **Year(s)**;
→ To view the average trend select **Multiyear parameter**;
→ To download the data click **Export data (CSV)**.

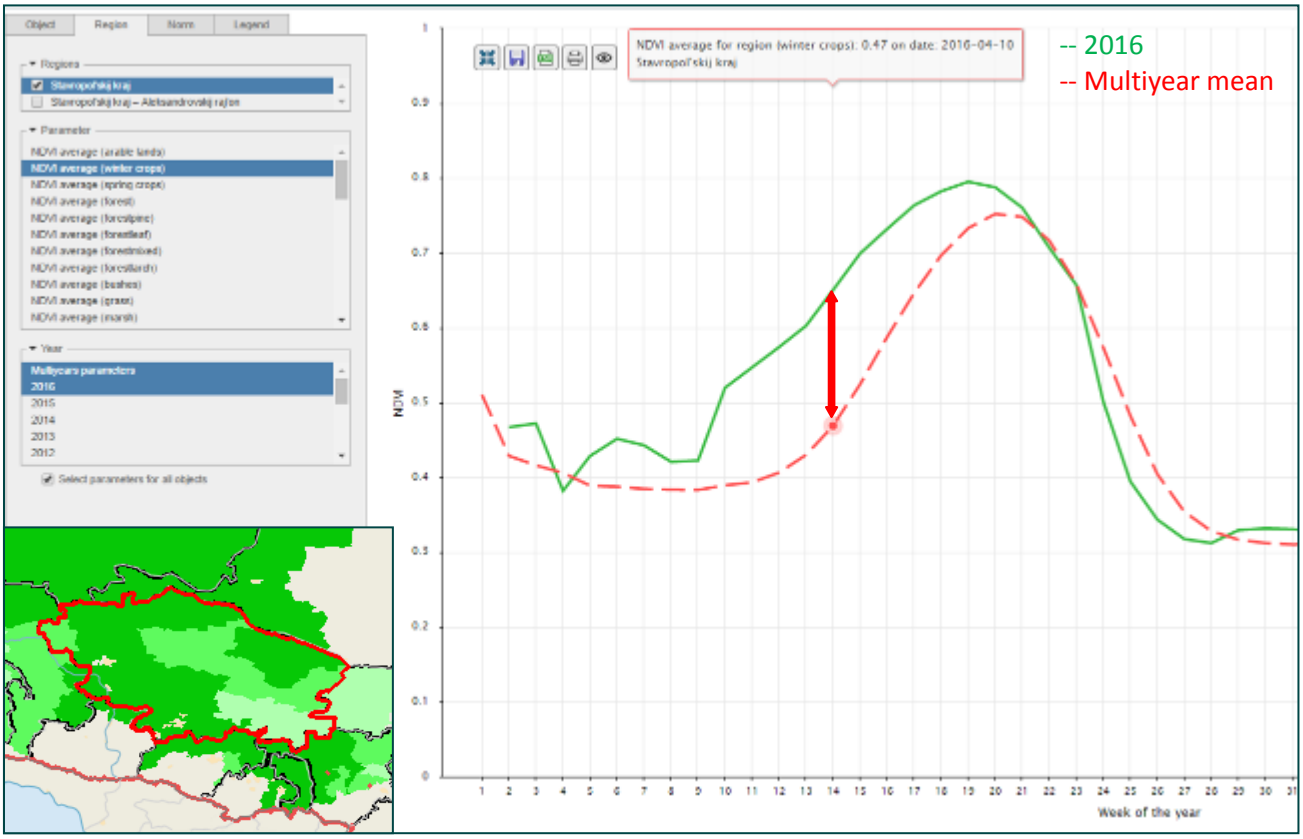


Figure 52: Picture shows extremely early development of winter crops in Stavropol region at the spring 2016. NDVI values exceed the norm more than 25%. NDVI trend analysis already in the beginning of the season allow us to suggest that all phenological stages are going to be shifted for approximately 3 weeks earlier in comparison with the multiannual norm and there are indicators to suggest that winter crop yields would be higher than usual.

Fire data

There is a way to monitor fires on cropland and non-cropland areas in VEGA-GEOGLAM. **Fire data** allows to get actual and archive information about the fire situation globaly. Fire spots are detected with MODIS Thermal Anomalies/Fire MOD14 product (updates few times a day) and then spots are combined into clusters using IKI technologies.

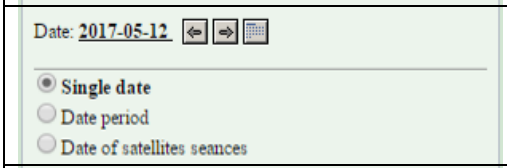
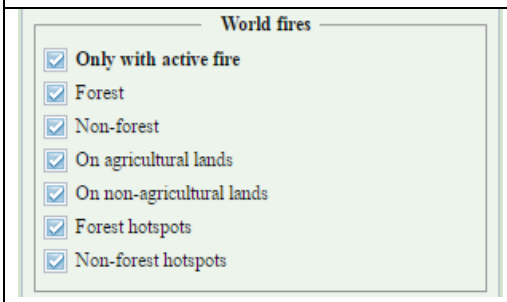
	Turn on/off the Fires tab
	Set the Date or Date period or Date from Moderate resolution tab (=Date of satellite seances);
	Select Fire ID numbers if you want to see the fire database number on the map
	Fire types: • Only with active fire - fires that are active (not put out yet) • Forest fires - based on MOD44 map • Non-forest - based on MOD44 map • On agricultural lands - based on IIASA Cropland map • On non-agricultural lands - based on IIASA Cropland map • Forest hotspots - based on MOD44 map • Non-forest hotspots - Hotspots on arable lands that are not integrated into one fire contour

Figure 53: World fires for the 13th of April 2017 according to satellite data

To see the current natural fire situation in the world:

→ Go to **Full extent**  ;
→ Go to **Fires;**
→ Set the current Date (set as default);
→ Select all types of fire.

For each fire there is information about:

- Fire type
- Borders
- Duration
- Area

Use **Query** to get the fire attributive information.

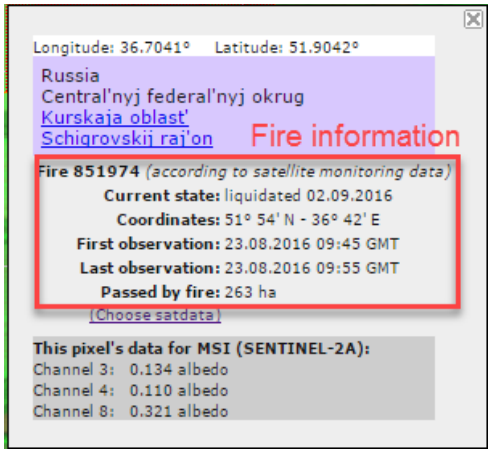


Figure 54: Fire information

Fires are often caused by grass burnings on the fields. VEGA-GEOGLAM helps to monitor stubble burning and

fires on arable and forest lands.

Figure below illustrates the work steps of detection fire on agricultural lands:
→ Navigate to your AOI;
→Go to **Fires (**fig.55, a);
→Set the Date or Date period or Date from Moderate resolution tab (=Date of satellite seances);
→Select Fire ID numbers if you want to see the fire database number;
→Select the **Type of fire;**
→ Find and select the satellite image from **Satellite Data** (High or Medium resolution) for the date of the fire or next to it to assess the damages (fig.55, c);
→ Use **Query** tool (click on the fire body) to get an additional information about the fire (fig.55, b).

Fire contours are in orange and red (on agricultural lands and on non-agricultural lands); burned areas appeared in deep brown colors at the MODIS image.

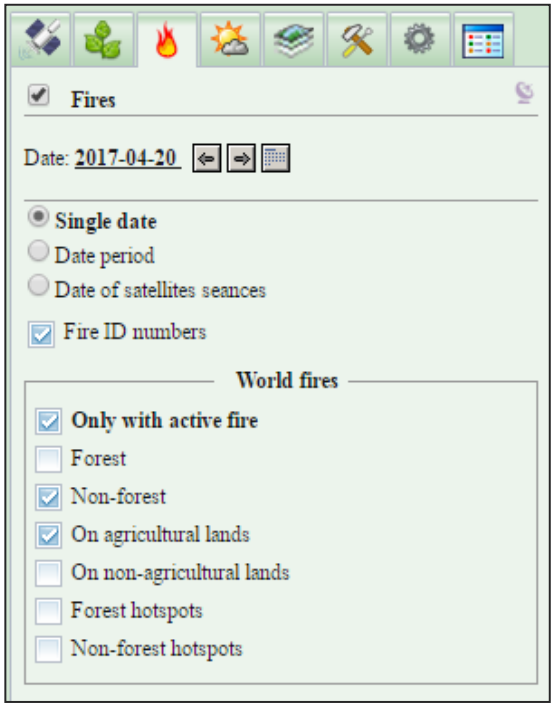


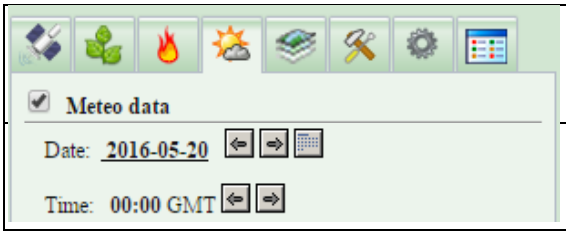
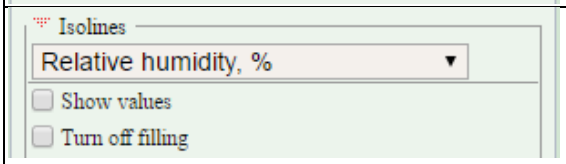
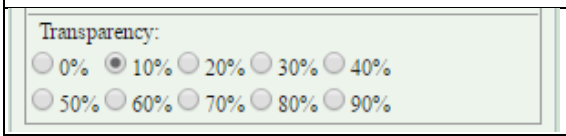
Figure 55: Stubble burning in Russia, Kursk region.
2016-08-23 Sentinel-2 image,
36.69 Lat 51.90 Lon.
a) Fire date 2016-08-23 (Active fires on agricultural lands are selected);
b) Info about the fire;
c) zooming to the burned area.

Meteorological data

Crop condition assessment and predictions need meteorological information. VEGA-GEOGLAM allows you to get access to the NCEP meteorological data archives.
Data sets are available from 2001 to nowadays with 4 times a day update frequency. Data resolution is 0.5°x 0.5°. Maps and meteorological parameters time series are available (fig.32, fig.33).

Meteorological data list:

- Temperature (minimum, maximum), °C
- Pressure, mbar
- Relative humidity, %
- Total/accumulated precipitation, kg/m²
- Downward/upward longwave/shortwave radiation, W/ m²
- Soil temperature (depth below land surface 10,40,100,200 cm), °C
- Soil humidity (depth below land surface 10,40,100,200 cm), %
- Snow cover, %
- Snow depth, m
- Hydrothermal index
- Normal (mean multiannual) max, mean, min daily temperature; relative humidity; total precipitation.

	Turn on/off the Meteo data tab
	Set the Date and Time
	Data set: Eurasia data or Global data. Eurasia data set contains more parameters than Global. Global data set contains forecasts (up to 2 weeks).
	Wind displays as direction arrows
	Select the parameter (isolines) to display (from meteorological data list). Turn on Show values to see the values of the selected meteorological parameter on the map. Color filling is set as default, you can turn it off.
	Set the transparency percent of filling color.

To view weather data on the map:
→ Go to **Full extent** or navigate to your AOI;
→ Go to **Meteo data;**
→ Set the **Date** and **Time;**
→ Select **data set (Eurasian or Global);**
→ Check the **Wind** displaying, if nesscesary (displays as direction arrows);
→ Select the **displaying parameter (isolines);**
→ Set the **displaying options** (value displaying, transparency options). Selected data will be displayed.

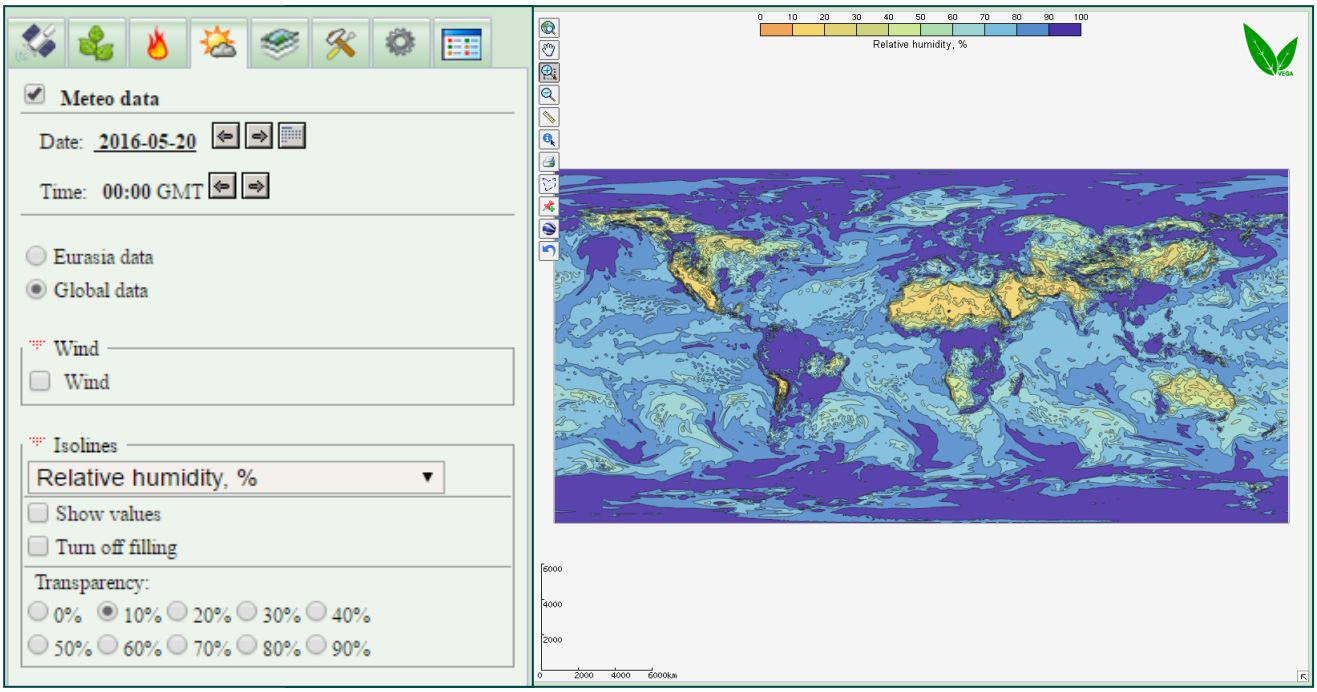


Figure 56: Relative humidity world map with 10% transparency for the May 20, 2016.

To view weather data on the graph:

→ Navigate to your AOI;
→ Go to **Fields vegetation state analysis;**
→ Select **Season** and turn on field counturs**;**
→ Click on any field with Query;
→ Go to graph interface;
→ Set the **displaying parameter(s) and year(s);**
→ To see the average values for the region, go to **Region** tab at graph interface.

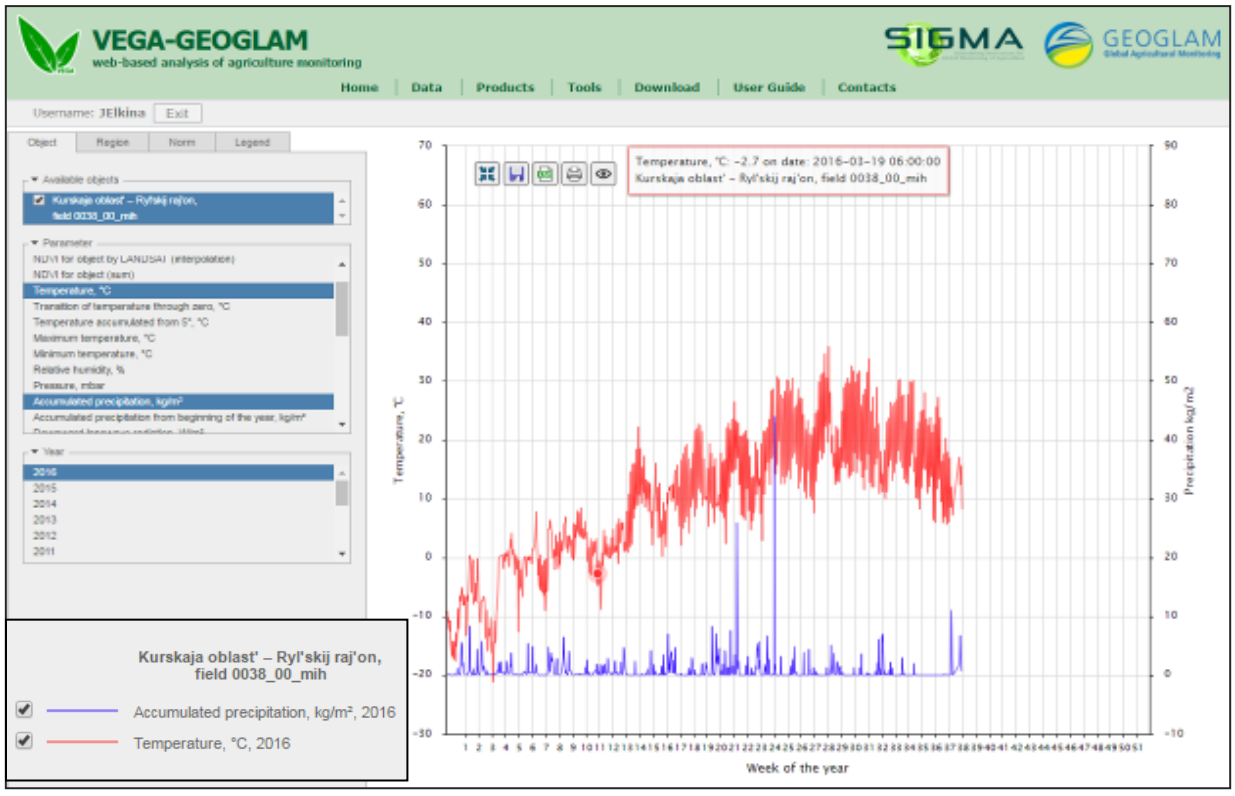


Figure 57: Accumulated precipitation and Temperature in 2016 graph for the field in Kursk region

Data analysis tools

VEGA-GEOGLAM data processing and analysis tools are located in **Data Analysis**  Group of tabs. The tabs (that are representing the tools) are:

- Basket;
- Image color enhancement;
- Point objects;
- Classification;
- User maps;
- Image algebra;
- Indices calculation;
- Band selection;
- Irregularity of vegetation;
- Pallet.

Basket

Basket stores all the images you have selected and added to the Basket at the Satellite Data tabs.
→ Select and Add to Basket any image(s) from **Satellite Data** (fig. 58);
→ Go to **Data Analysis** → **Basket**

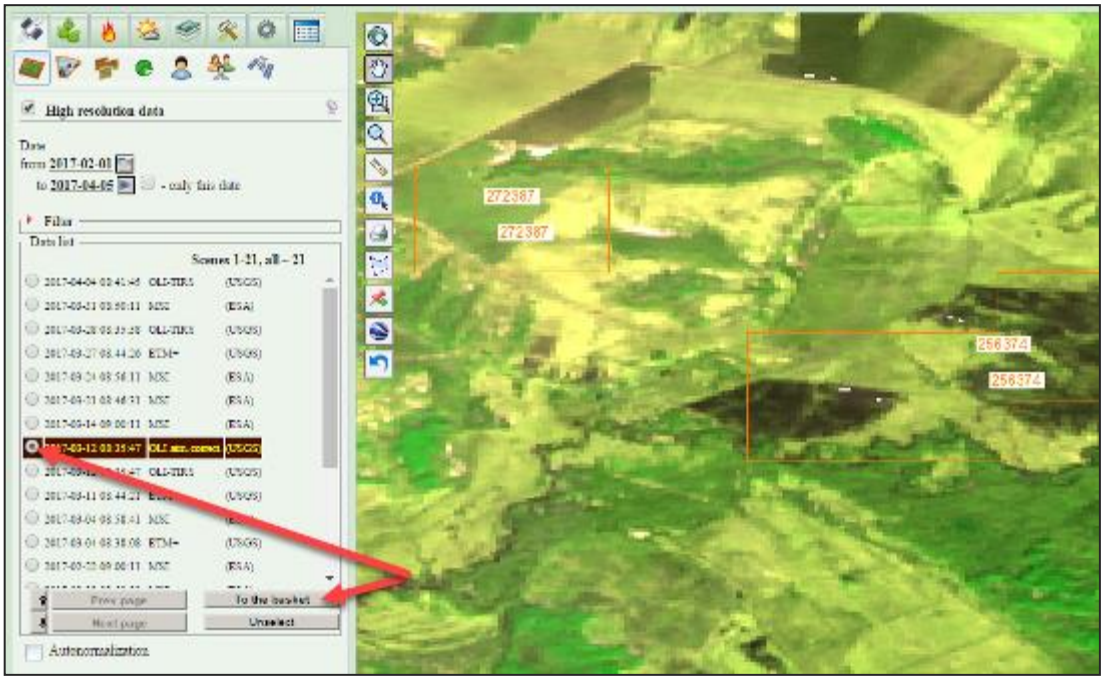
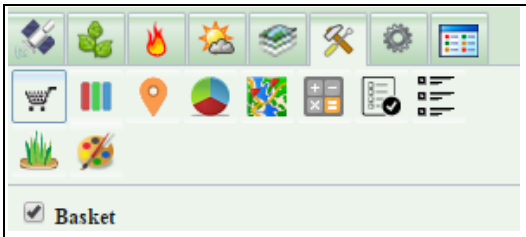
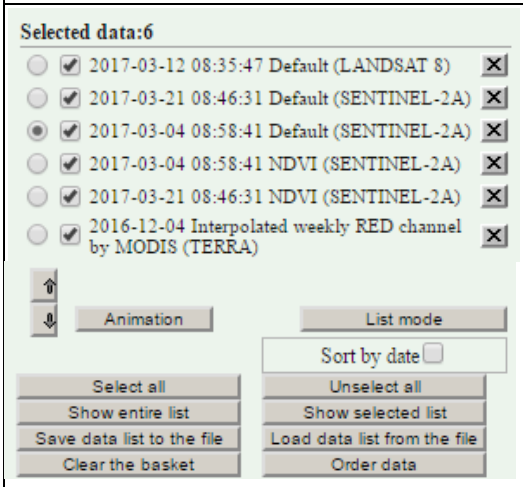
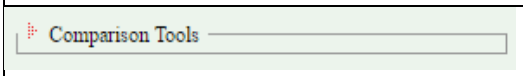


Figure 58: Adding satellite image to the Basket.

Being added to Basket, an image became available to processing using various tools (Color Enhancement, Map algebra, Classification and other) and also it became available to download. Use an option “save the Basket” to save the images from current work session.
You can also add to Basket images/Earth Observation product from other tabs, for example, any result of classification (result map).

	Turn on/off the Basket tab
	**Selected data** – list of satellite images **Animation** - use Animation to view them automatically one after one **Sort by Date** - arrange images by date and view them consistently **Show entire list/Shoe selected list** – only selected images are available for ordering (downloading) **Save data list to the file/Load data list from the file** - save the list of these images (in .txt) and then open it at the next work session or send it to your colleague **Clear basket** – deletes all images from the Basket **Order data** - download (order) the images.
	**Comparison tools** - compare two images using slider tools
	**Georeferencing tools** – allows to manually georeference a satellite image.

How to download an image

→ Find images and add them to the **Basket;**
→ Go to **Data Analysis** → **Basket**;
→ Select an image(s) to download in the Basket list (you can use an option **Select All**);
→ Click **Order data;**
→ In the pop-up window you'll see list of ordering scenes. **Confirm** your choice;
→ You'll receive e-mail with the download link.

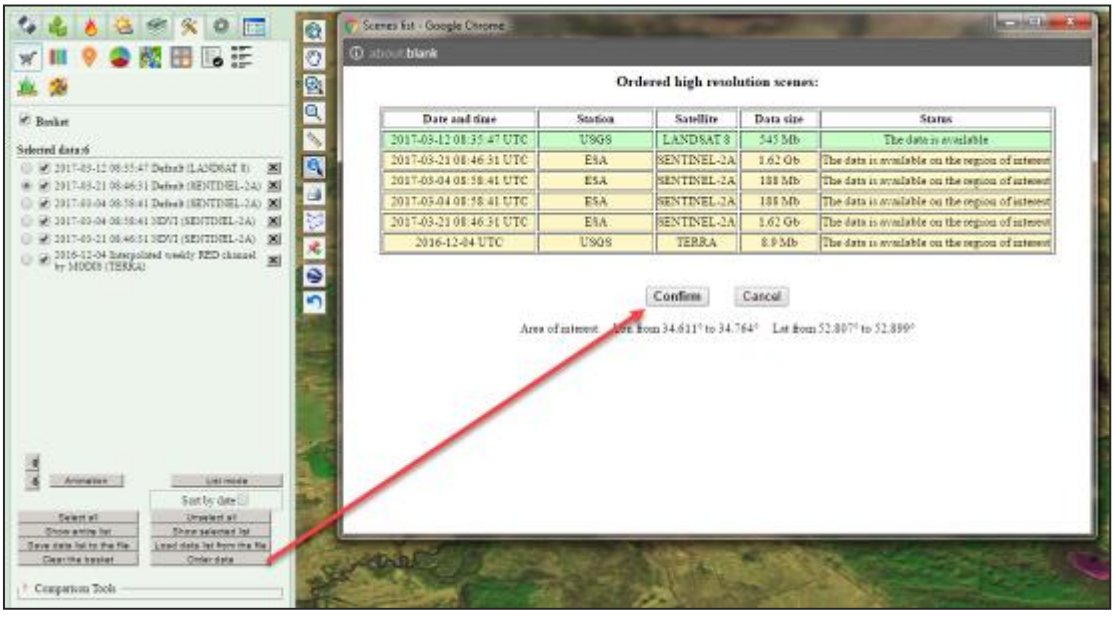


Figure 59: Satellite image downloading.

Data comparison tools

There are two slider tools to help you with comparison of two satellite images: Transparency slider and Swipe Tool. To use these tools first you should choose a Basis image and an Image to compare.

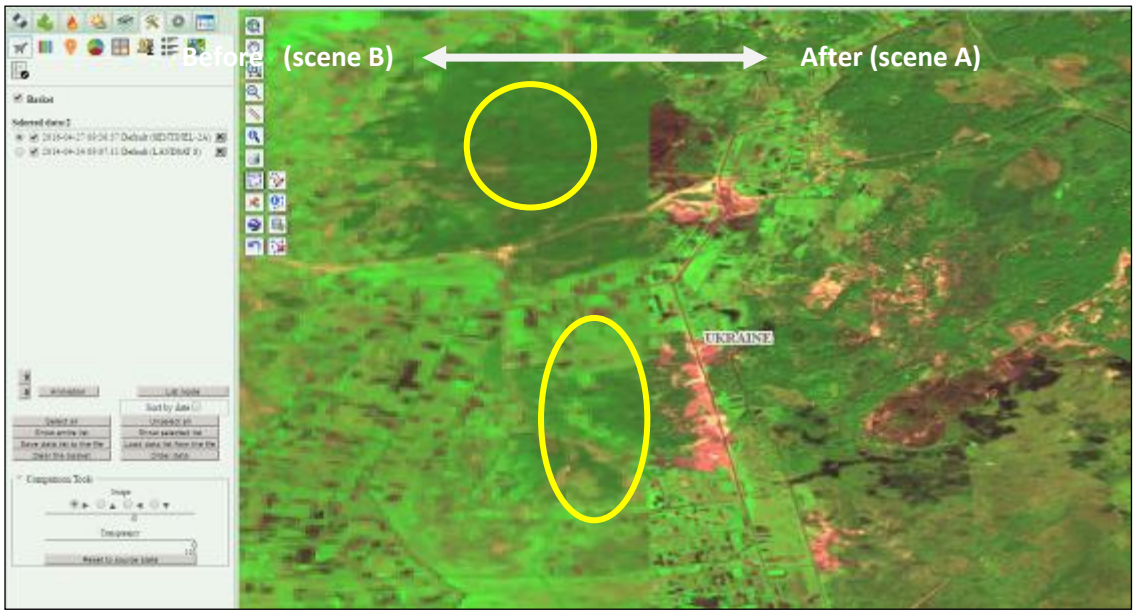


Figure 60: Slider tools are usable for visual landcover change assessment. In this picture:

Scene A – 2016-04-27 Sentinel 1-A image, 10 m spatial resolution
Scene B - 2014-04-24 Landsat 8, 30 m spatial resolution
Comparing two images from 2014 and from 2016 years, we can notice some landcover changes owing to an extensive environmental management (on the top: forest, on the bottom: amber mining. Difference of satellites resolution is also noticeable.

To use slider tools:

→ Navigate to your **Area of Interest**;
→ Go to **Satellite Data**;
→ Find and select the scene A (basis image), select it and put to the **Basket**;
→ Find and select the scene B (an image to compare), select it (it is not necessary to put it to the Basket);
→ Go to **Basket;**
→ Select the scene A;
→ Open **Comparison Tools** block;
→ Move Transparency slider or use Swipe slider. Scene A will slide over the scene B.

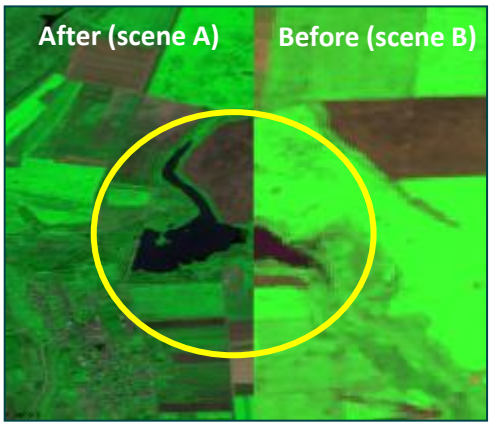


Figure 61: Comparison Tool.

Figure 61: visual image analysis is a good change detection method. In this picture: water reservoir got smaller in 29 years.

Scene A – 2014-08-23 Landsat 8, 30 m spatial resolution
Scene B - 1985-08-23 Landsat 5, 80 m spatial resolution

Point objects

There is a special tab for group creation - **Point Objects.** To add fields to comparison:

→ Go to **Data Analysis** → **Point objects;**
→ Click **Add new Group** and set **Name, Description** and **Color** for the points. You can create several groups.

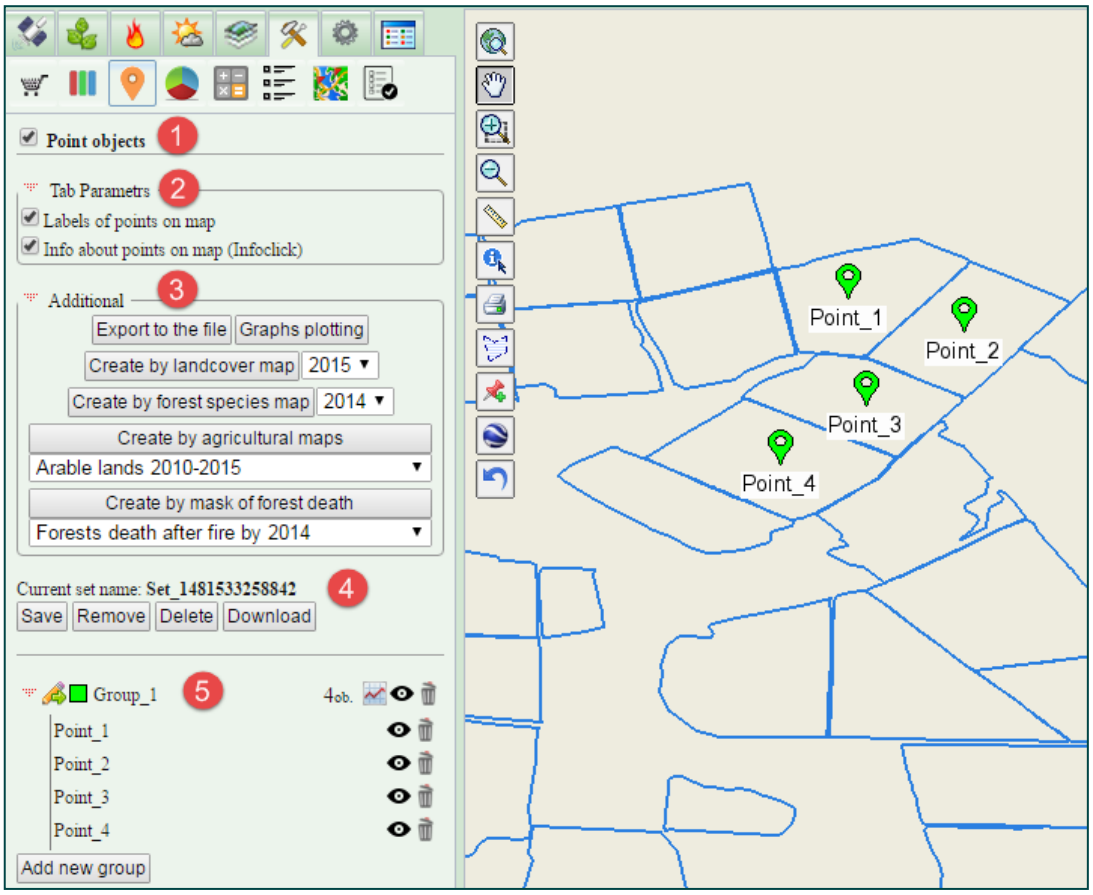


Figure 62: Point object tab:

*1- Turn on/off the **Point objects** tab*
2- Displaying options (show labels)
3- Additional options (group of points downloading, creating points from thematic maps)
4- Set of groups options (save, remove set of groups)
5- Group of point's workspace

→ Make the Group editable;
→ Using Add point objects instrument add points (samples of the object from this type of objects) to the group

Group of points workspace:

1- Open/close the Group, change the color
2- Amount of the objects
3- Open **Graph time series Interface**
4- Show/hide point
5- Point names
6- Deleting the point/the Group

Figure 63: Group of point's workspace.

Classification tool

Satellite image classification allows to group pixels of a satellite image to separate classes according to certain parameters. This can be used for definite features identification and for thematic maps creation.
Using classification you can separate arable and non-arable lands, identify land use types, identify winter crops fields, control land usage.

The basic requirement for image classification is image itself but the other important thing is knowledge of the region for which you are going to classify the image.

→ Go to **Data Analysis** → **Classification** 

There are two main types of image classification:

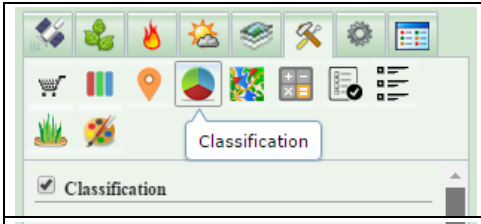
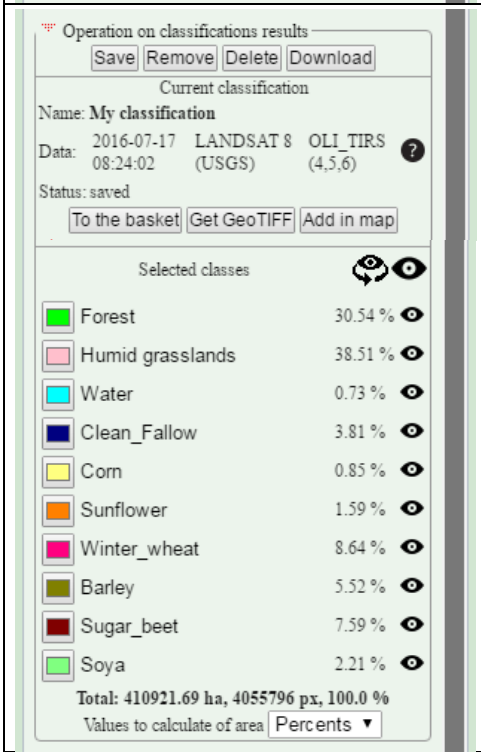
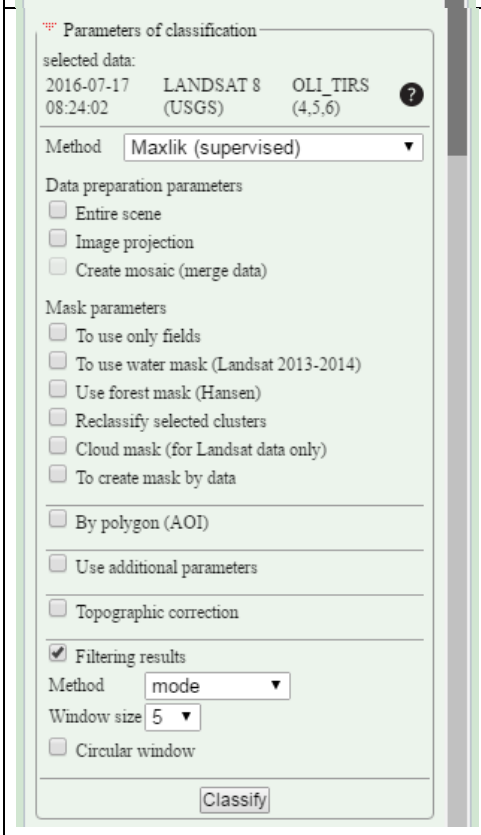
1. Supervised classification - a user selects representative samples for each land cover class in the digital image, the call training samples. The image classification software uses the training sites to identify the land cover classes in the entire image.
VEGA allows to you to use training samples from the MODIS-derived thematic maps and to classify images with higher resolution, such as Landsat or Sentinel.

2. Unsupervised classification - requires no advance information about the classes of interest. Rather, it examines the data and breaks it into the most prevalent natural spectral groupings, or clusters, present in the data.
Pixels are grouped based on the reflectance properties of pixels. User identifies the number of clusters to generate and which bands to use. The analyst then identifies these clusters as landcover classes through a combination of familiarity with the region and ground truth visits.
Classification methods used in VEGA-GEOGLAM are presented in Table 6.

Table 6. Classification methods

Method	Type	Description
Clustering	Unsupervised	http://grass.osgeo.org/grass64/manuals/i.cluster.html
Sequential Maximum a Posterior (SMAP) Algorithm	Supervised	http://grass.osgeo.org/grass64/manuals/i.smap.html
Maxlik (Maximum-likelihood discriminant analysis classifier)	Supervised	http://grass.osgeo.org/grass64/manuals/i.maxlik.html
One-class clustering	Supervised	The method performed on the basis of Clustering with the following cluster selection according to the training sample.

Classification tab provide classification tools with configurable options.

	Turn on/off the Classification tab
	**Classification results** The section opens after the performed classification (List of clusters and management buttons)^ 1. Name of classification task, the used data, the result status (saved/not saved in VEGA-GEOGLAM). There are management buttons: **To the basket** (put the result map in the Basket), **Get GeoTIFF** (download the result image), **Add in map** (Add the result image to the User Map tab). 2. Selected classes: here the list of clusters is displayed. Class name, color are editable parameters. There is presence per class for each cluster, as well as area per class (in ha and in pixels).
	**New classification parameters setting:** **Selected data** – selected scene and bands (choose any at the **Select Bands** tab) **Method** – select the classification method; **Data preparation parameters** – choose the area for classification: entire scene or visible extent; combination of several scenes (mosaic creation). Visible extent area is set as default. **Mask parameters** – define a mask for classification. There are various masks available. You may perform the classification within the fields borders (active borders from the Field vegetation tab would be used. **By polygon** – you may perform classification within the borders of the polygon. To draw a polygon, use the drawing tool. **Use additional parameters** – classification fine tuning. **Topographic correction** – automatic topographic correction for every band. **Filtering results** – the result of the classification can be filtered to remove various noises. Mode method with 5px window is set as default. **Classify** - click here after parameter setting to start the satellite image classification.

General satellite image classification steps in VEGA-GEOGLAM:

1. Choose the scene and the bands:

→ Navigate to **your AOI;**
→ Go to **Satellite data**. Find, select and add to **Basket** the scene(s) to classify (fig.64, a);
→ Go to **Data Analysis** → **Bands selection and select** the bands of the image(s) (fig.64, b);

Pay attention to the field in green color: they all seem quite similar in the “natural color” band synthesis, while they are fields with the different crops. For cropland mapping we should use NIR and RED channels (4, 5, 6 for Landsat 8 OLI-TIRS) to separate different crops from each other, based on their spectral reflectance in these channels.

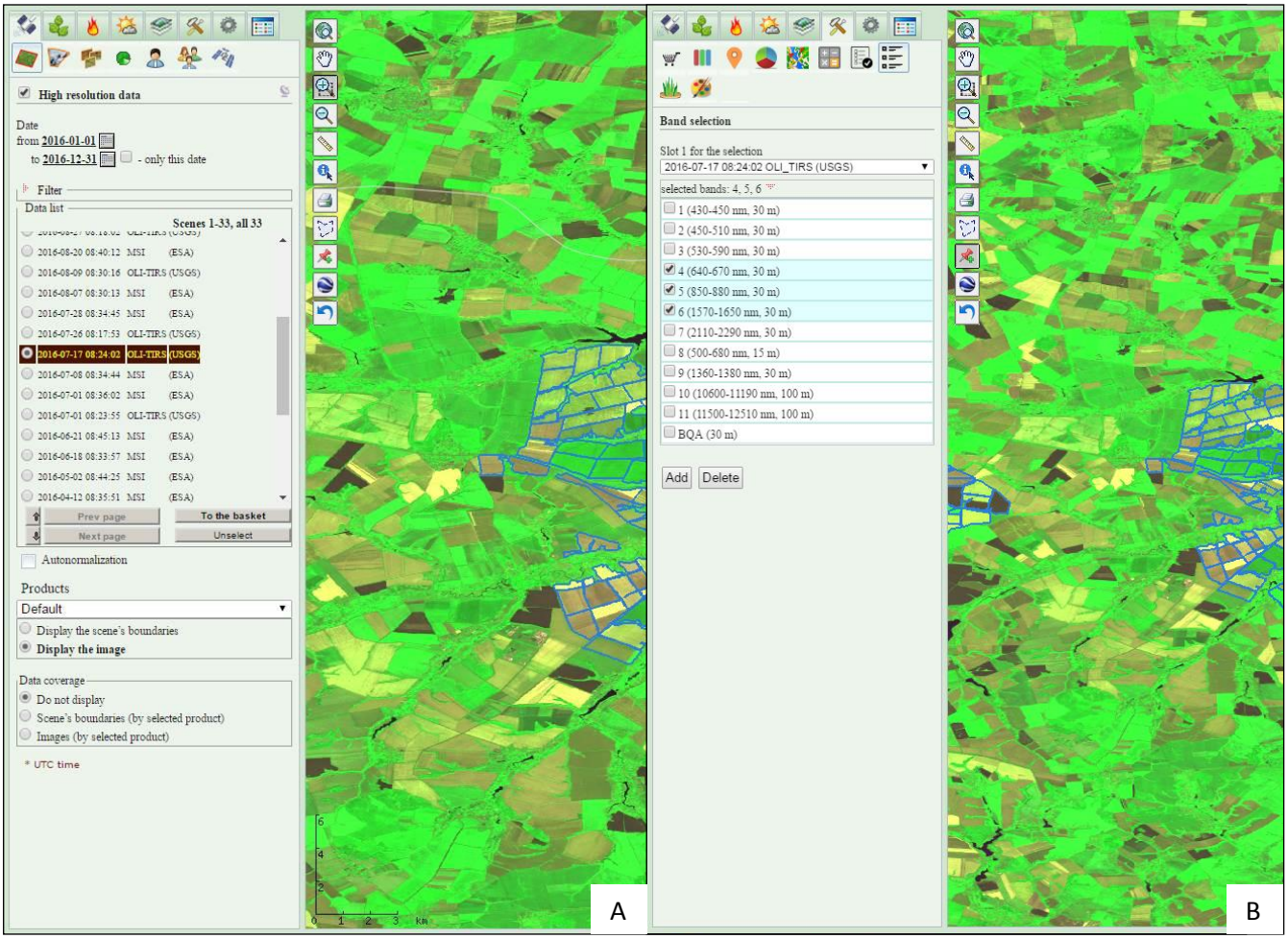


Figure 64: a) find and add the satellite image to the Basket, b) select the bands.

2. Prepare data
→ for supervised classification set the training samples (points) at **Point objects;**

During classification all pixels of the image will be assigned to the classes that the specified by user. Therefore, you need to create as many groups of points as many clusters you want to see in result map. Create group of points for each type of classification objects. Collect approximately the same number of points for each type of object.

You may use any base maps and satellite images for image interpretation and to the training samples collection. Figure 54, a illustrates usage of the high resolution Digital Globe map. Winter satellite images are good for forest detection. Figure 54, b illustrates the usage of crop information for some fields. It is very helpful information that will allow us to get the cropland map for wider area (all scene or visible extent).

Figure 65, c illustrates the usage of agricultural clean fallow map (blue spots are clean fallows).

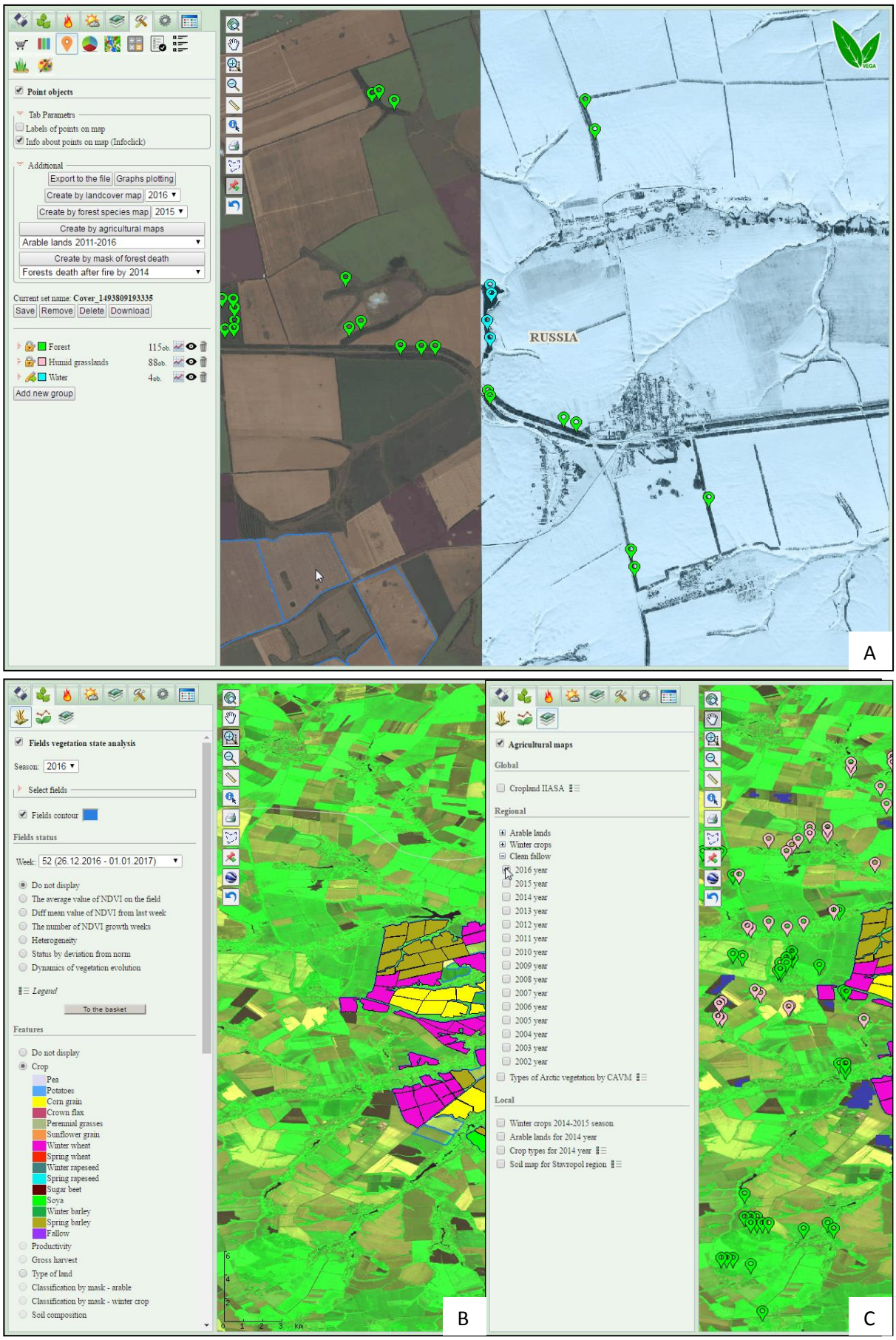


Figure 65: classification steps

Create as many groups (classes) as many clusters you want to see in result map. Create group of points for each type of classification objects. Collect approximately the same number of points for each type of object. Put points precisely in the object boundaries, do not mix points from different classes (fig.66, a).
Figure 66, b illustrates the final phase of collecting the training samples. 10 groups of different objects were created, from 53 to 77 points in each.

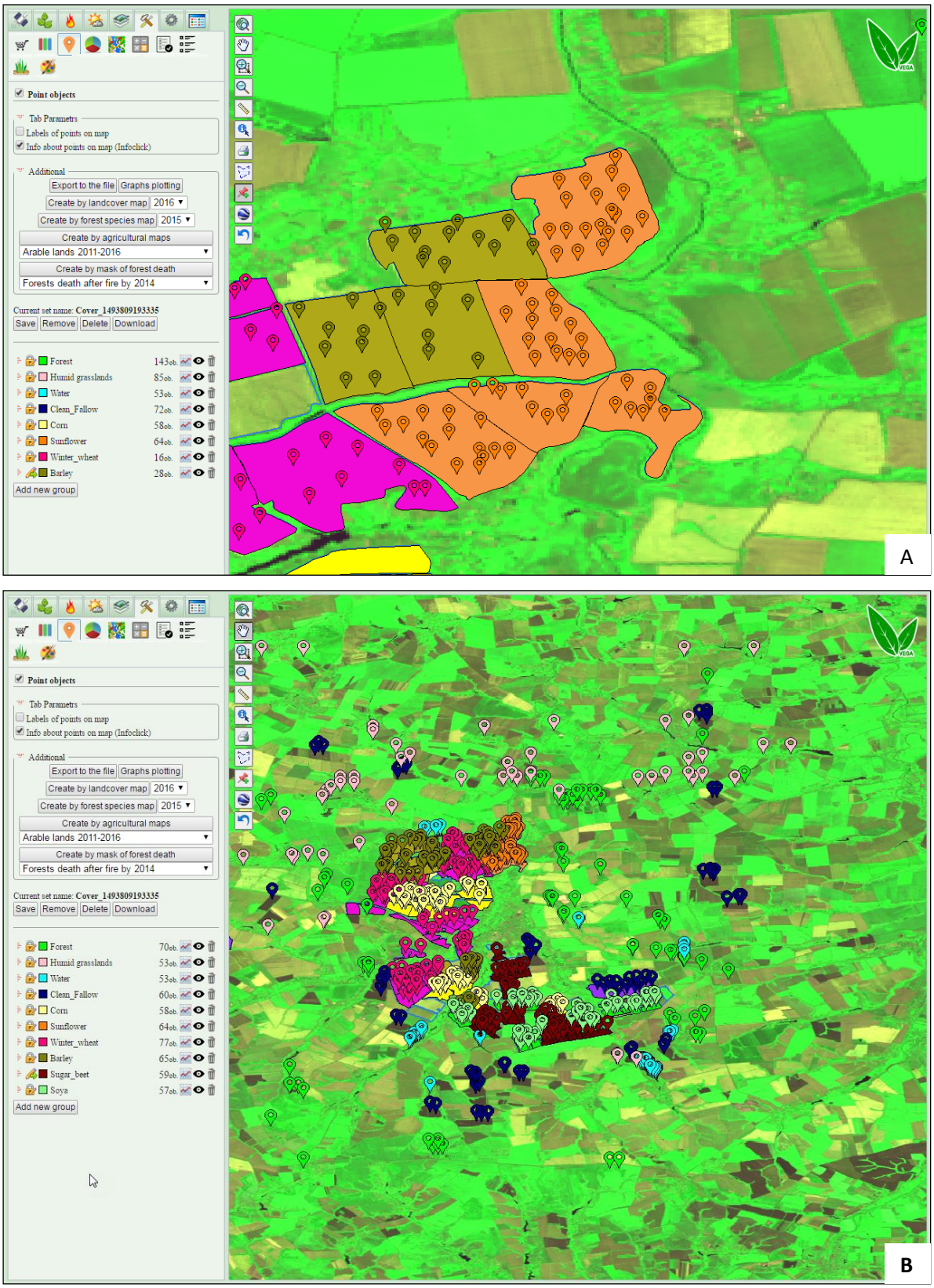


Figure 66: the training samples collection

2. Choose a classification method and define the parameters
When the training samples collection is finished:

→ Go to **Data Analysis** → **Classification;**
→ Define the classification method and classification parameters: define an area for classification (visible extent will be classified as default), a mask for classification, filtering parameters and other, if necessary. Figure 67, a shows that Maxlik (supervised) classification method was chosen with the Filtering mode method with 3 px window size.
→ At **Classification** click Classify. (fig.67, b)

The task will be queued for processing and will be displayed in the same tab after it completes.

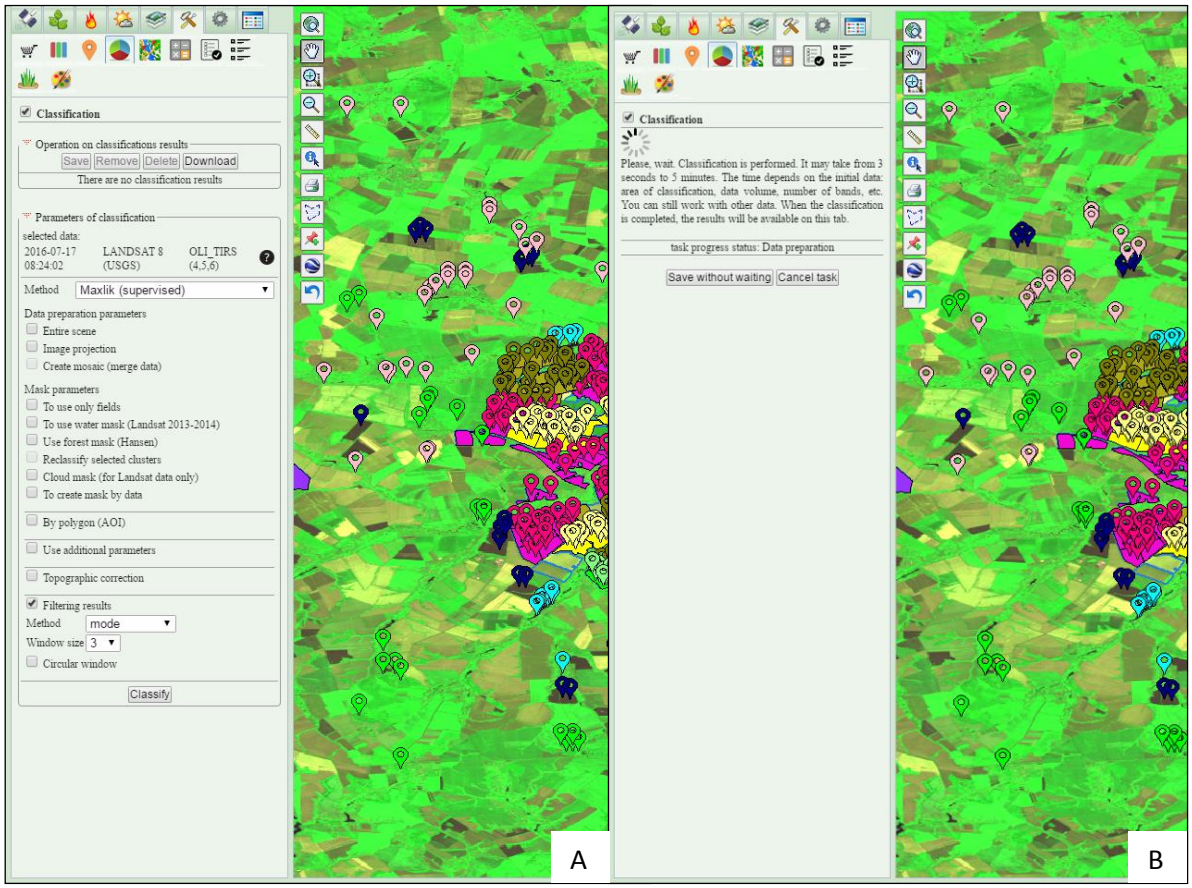


Figure 67: classification settings

Classification result would be displayed at the interface and the Current classification section with the results of classification (list of clusters with the presence per class) will be appear at the Classification tab (fig, a).

→ You may save the result and training samples in VEGA-GEOGLAM for further work, download the result as GEOTIFF image, create a map, perform a reclassification or change any classification parameter and to classify the original image once more.

Figure 68, b illustrates the repeated classification with the other Filtering settings (5 px window instead of 3px).

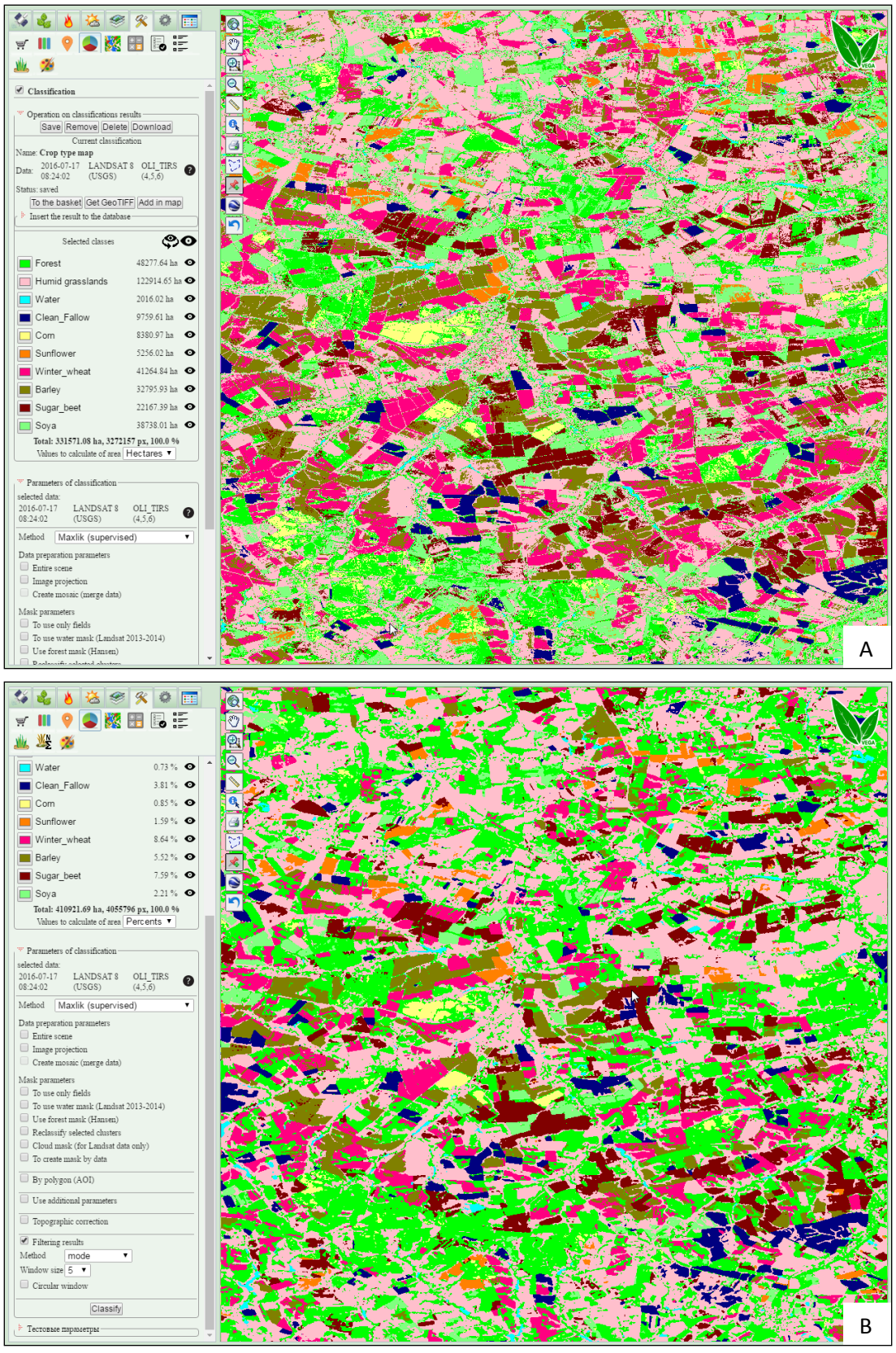
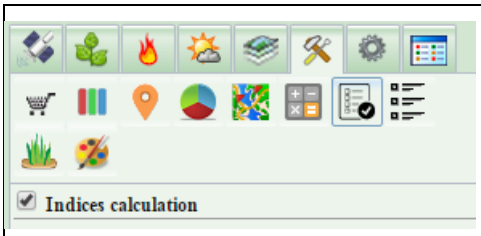
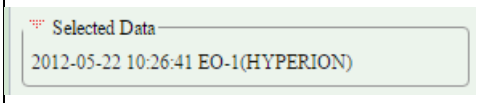
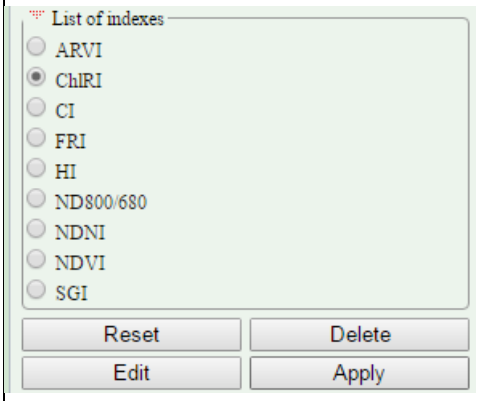
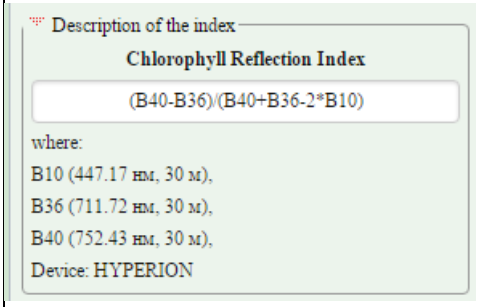


Figure 68: Result of satellite image classification – crop type map for the territory in Kursk region. Crop type data for the only 20 fields was used, as well as data from clean fallow map and data derived from the visual image interpretation.

Indices calculation

Satellite-derived indices are indicators of the state of objects (vegetation, atmosphere, water objects) that results from mathematical operations with different satellite image's spectral bands. To create an index map from raw satellite data about light waves mathematical formulas are applied. Index maps are usable in vegetation conditions and vegetation developing monitoring, yield prediction, climatic variability.

There is **Indices calculation** tab in VEGA-GEOGLAM that allows easily to calculate an index from the wide range of satellite-derived indexes, such as NDVI, EVI, ChlRI and other widely used ones.

	Turn on/off the Indices calculation tab
	Selected data section (data from the Basket)
	Choose the satellite to see the available indices
	Choose the index type (Agriculture/Atmosphere/Fire/Forestry/Soil/Vegetation). There is a certain type subset for an each satellite.
	From the List of indices choose the index.
	Description of the index window (formula window)

To calculate the index:

→ Find, select and put into the **Basket** the high resolution satellite image;
→ In the **Basket** select the one image;
→ Go to **Indices calculation;**
→ You will see the **selected image**;
→ From the drop-down list of the satellites choose the satellite to see the available indices;
→ From the drop-down list of the indices types choose the index type (Agriculture/Atmosphere/Fire/Forestry/Soil/Vegetation);
→ From the **List of indices** choose the index. The index formulas will appear in the **Description of the index** window;
→ Click **Apply** to start the calculation. The result of the calculation is a new image (fig.69).

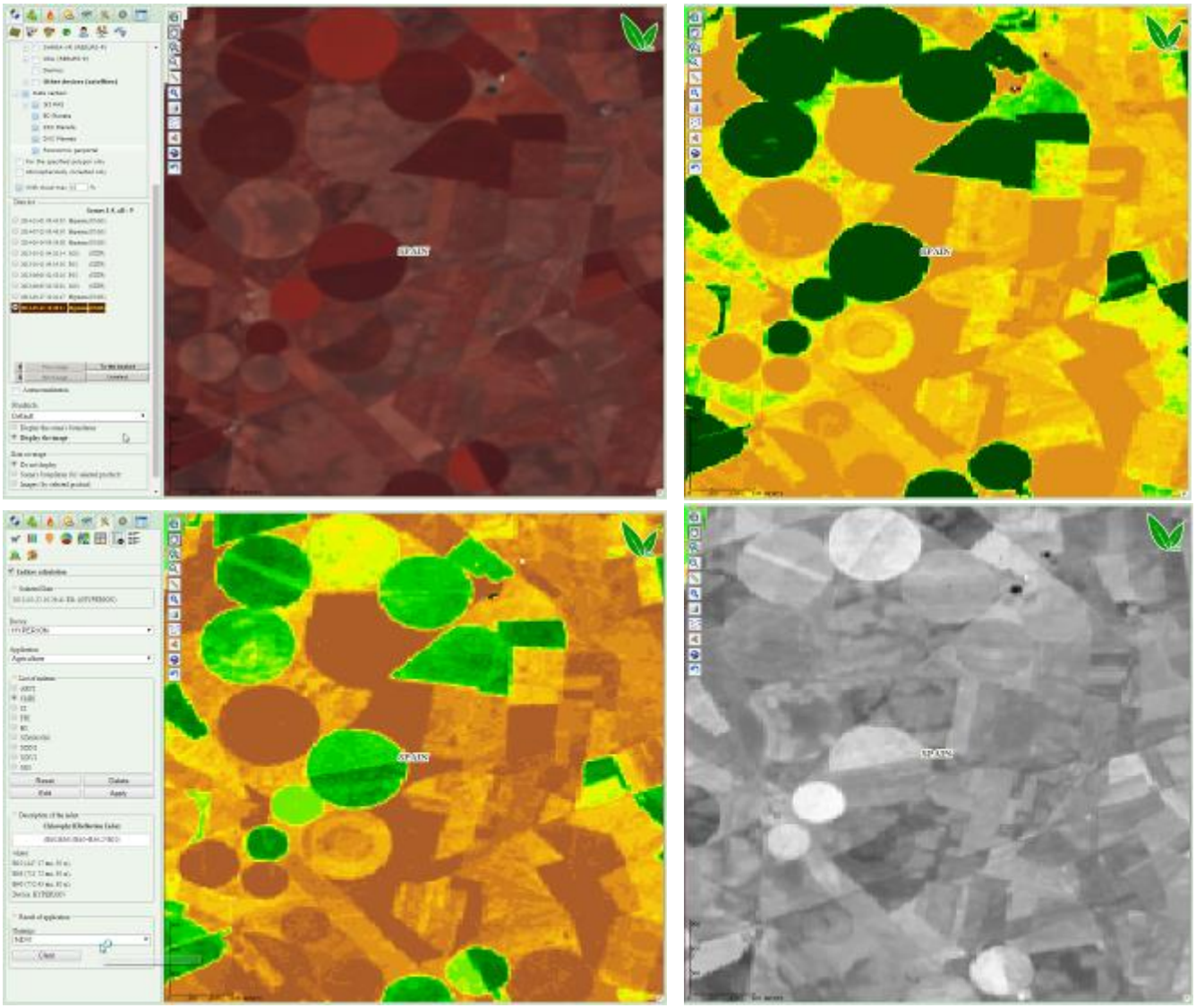
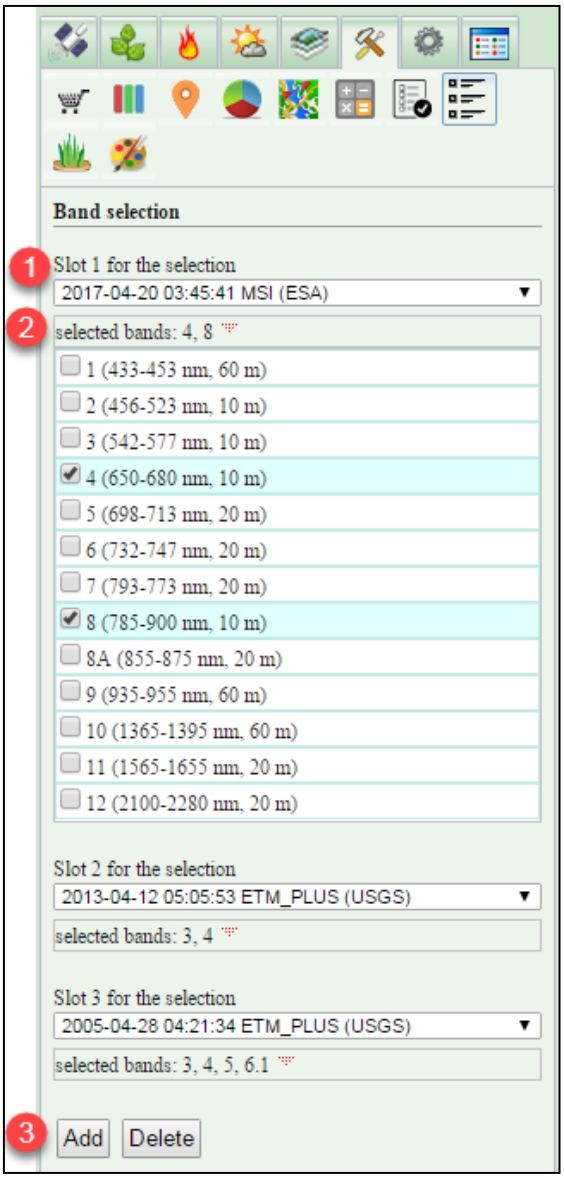


Figure 69: indices calculation example.

Band selection

→ Go to **Data Analysis** → **Band selection**

At the Band selection tab a user chooses spectral channels of the scenes from the **Basket** (you should preliminary find and put satellite images into the Basket) to use at any image classification task (**Classification tab**) or at any raster calculation task (**Map algebra tab**).



To choose satellite bands:

→ Go to **Band selection**;
→ From the drop-down list of the satellite images from the Basket (**Slot 1 for the selection**, fig. 7 (1)) choose the satellite image. List of corresponded bands will appear;
→ Select the required bands (**selected bands**, fig. 7 (2));
→ Repeat the two first steps for the other images and bands by clicking **Add** - it's adding a new cell. To delete the last one use **Delete** (fig. 7 (3)).

The band designations for an each satellite you may found at the official satellite websites:

Landsat - https://landsat.usgs.gov/what-are-band-designations-landsat-satellites;
Sentinel-2A - https://earth.esa.int/web/sentinel/user-guides/sentinel-2-msi/resolutions/spatial;
MODIS - https://modis.gsfc.nasa.gov/about/specifications.php.

Palette

→ Go to **Data Analysis → Palette**

Paltte tool allows user to change the pallet of the image or to display only some values higher or below a prescribed threshold.
Tool can be used with the moderate resolution imagery (MODIS, AVHRR, VIIRS, MSU-MR) and with Landsat 7, Landsat 8, Sentinel-2A NDVI products.

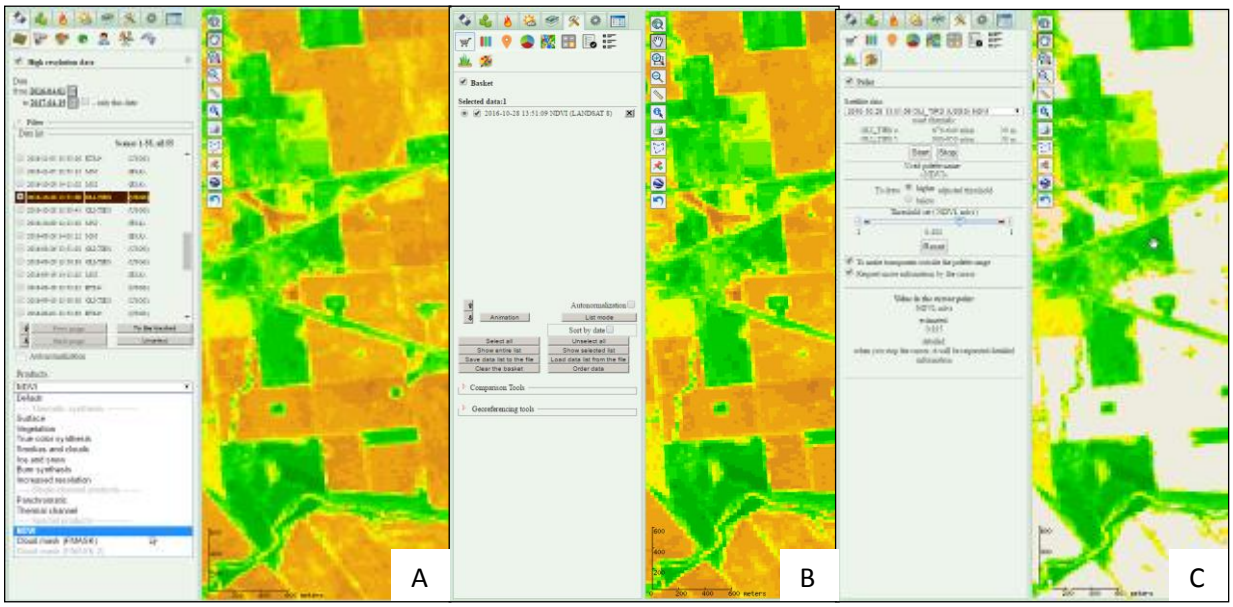
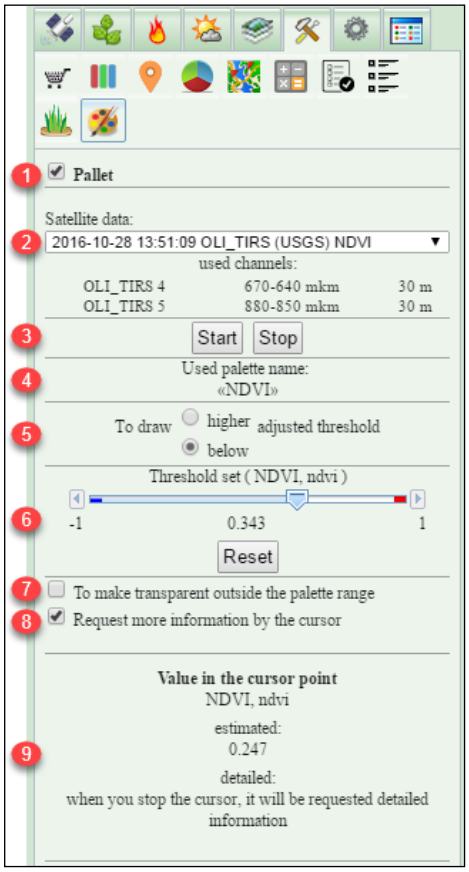


Fig.70 Palette tool allows to color the data only above (or below) a prescribed threshold. It is usable for detecting areas with a certain NDVI values at the satellite images in VEGA-GEOGLAM.



To use Palette tool to set up the way NDVI will be displayed:

→ Navigate to your AOI
→ Go to **Satellite data → High resolution data**
→ in **Products** select NDVI (a)
→ Find and select the the appropriate satellite image
→ Put it (NDVI map of chosen image) to the **Basket (b)**
→ Go to **Data Analysis → Pallet (c)**
Now you can turn off the Satellite images and Basket tabs.

At the Palette tab **(1):**

→ The chosen image will be shown at Satellite data window (2);
→ Press **Start (3);**
→ The Pallet name applied to the scene (4);
→ Specify displaying options (higher or below the threshold) (5);
→ Set the **Treshold** by moving the slider left or right (6);
→ Press reset to reset the treshold;
→ Use the **To make transparent outside the palette range** option (7) to display only the filtered values (you may use any other satellite image at the the transparent area as a base map);
→ Use the **Request more information by the cursor option (8)** to get the pixel (NDVI) value (9). Tab shows the pixel value for cursor pointed pixel.

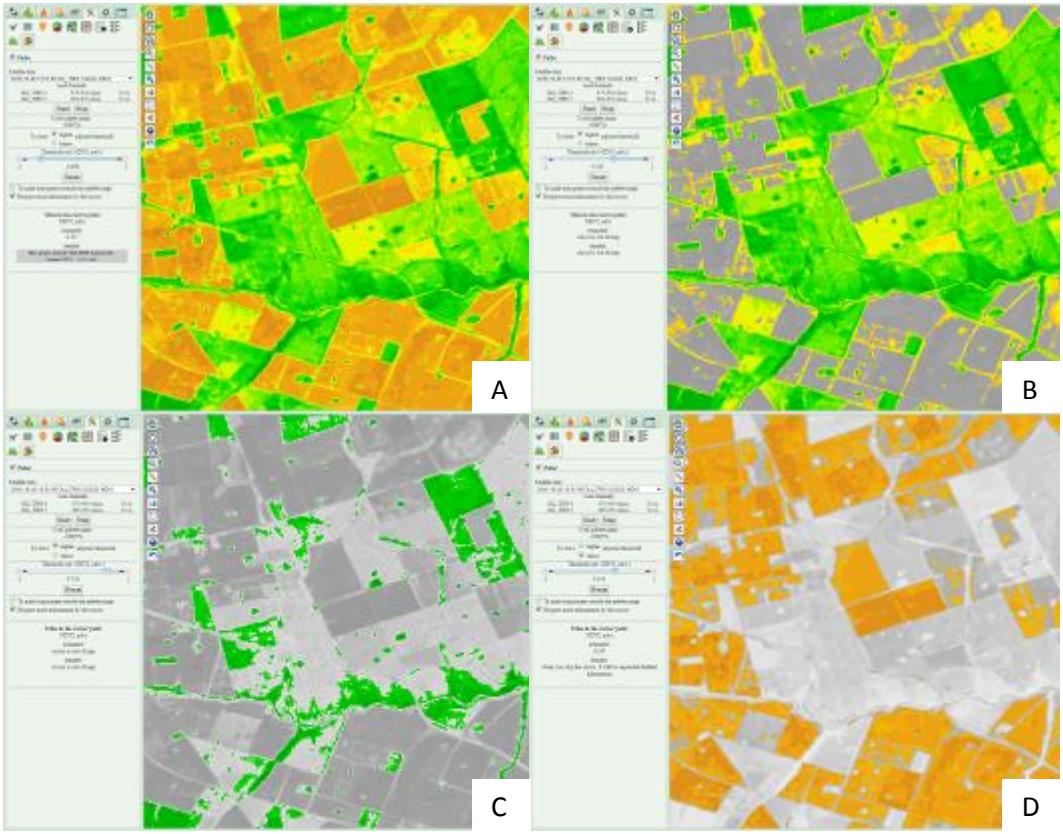


Figure 71: an example of the Palette tab usage for the intense vegetation and land without vegetation detection.
a – The original image (LANDSAT 8 NDVI map, 2016-10-28, the Argentinean SIGMA-JECAM test site);
b - show all NDVI values above the 0.343;
c - show all NDVI values above the 0.716 (healthy vegetation);
d - show all NDVI values below the 0.343 (poor vegetation).

IV. HOW-TOs

- How to register
- How to navigate to your area of interest (AOI)
- How to search and find satellite images
- How to download an image
- How to use slider tools to compare two satellite images
- How to create a field (a polygon object) to monitor
- How to work with Field Passport
- How to get NDVI map for the chosen area
- How to view NDVI and meteorological parameter time series for the field or region
- How to compare the current NDVI trend with the multiannual standard (norm)
- How to compare group of fields by NDVI and meteorological parameter graphs
- How to assess the crop development in a field with:
  - Satellite image interpretation;
  - NDVI graphs and maps;
  - Crop status cartograms;
- How to assess land usage at you area of interest with:
  - VEGA-GEOGLAM thematic maps;
  - Image classification;
- How to upload your data to the system

ACRONYMS & GLOSSARY

AOI	Area Of Interest
API	Application Programming Interface
CSV	Comma Separated Value
EO	Earth Observation
GEOGLAM	Global Agricultural Monitoring Initiative
GIS	Geographic Information System
HR	High Resolution
ISS	International Space Station
JECAM	Joint Experiment of Crop Assessment and Monitoring
MR	Moderate Resolution
NDVI	Normalized Difference Vegetation Index
R&D	Research And Development
SIGMA	Stimulating Innovation for Global Monitoring of Agriculture
VCNI	Weekly Vegetation Condition Normal Index
WVCI	Weekly Vegetation Conditions Index

