Space Research Institute

VEGA-GEOGLAM
web-based analysis of agriculture monitoring

SIGMA
Stimulating Innovation for Global Monitoring of Agriculture

GEOGLAM
Global Agricultural Monitoring

VEGA-GEOGLAM service

User guide

Moscow – 2015

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List of acronyms

R&D - Research and Development

EO – Earth observation

HR – High resolution

MR - Moderate resolution

TC - Temporal composite images

NDVI - Normalized Difference Vegetation Index

SWVI – Short Wave Vegetation Index

NDSI - Normalized Difference Snow Index

SMAP - sequential maximum a posteriori estimation

Maxlik - maximum likelihood estimation

NCEP - National Center for Atmospheric Research

NOAA-AVHRR National Oceanic and Atmospheric Administration - Advanced Very High Resolution Radiometer

1. Introduction

The VEGA-GEOGLAM web-based analysis system is developed by the Russian Academy of Sciences Space Research Institute in framework of the EC FP7 SIGMA project.

The VEGA-GEOGLAM is aimed at providing tools for analysis of the Earth observation data, results of their processing and other related information with particular focus at SIGMA-JECAM test sites for agricultural monitoring focused R&D activities. The VEGA-GEOGLAM is implemented using the concept of geospatial information web-service gathering satellite and other geographic information from different sources and providing access to users worldwide.

The VEGA-GEOGLAM provides access to near-real-time updated MODIS and Landsat data archives, DEIMOS data and other geospatial information collected over SIGMA-JECAM test-sites. The service performs automated pre-processing of MODIS and Landsat satellite data with daily update.

The VEGA-GEOGLAM is focused at facilitating agricultural lands and crops state analysis using vegetation indices time-series based on its seasonal and multi-annual dynamics at user-specified polygons (objects).

This tool is hence mainly positioned towards the partners of the SIGMA project. However the VEGA-GEOGLAM service offers also access to this pre-processed data for a wider community.

2. Users registration

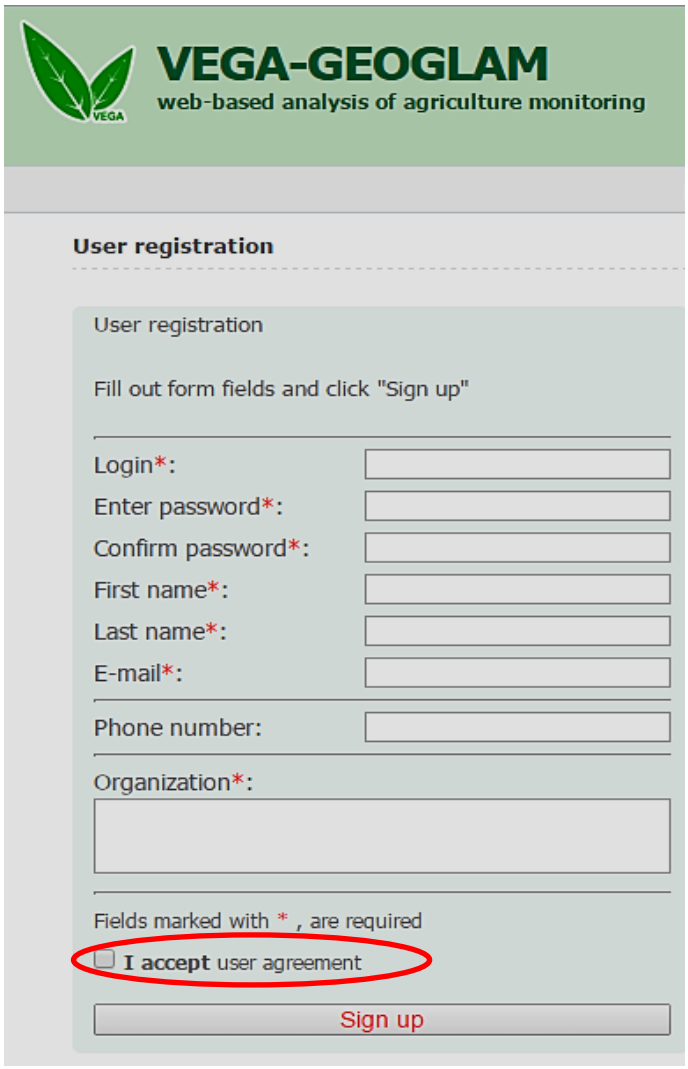
Accessing the VEGA-GEOGLAM a user has to agree to be bound by the terms of the User Agreement. A user has to fill a registration form and also read and accept the provisions of the User Agreement by clicking "I accept". Accepting the Agreement a user assumes the obligation:

- to provide his/her name, the organization and email address;
- to enter a login name and password;
- not to provide access to his/her account to other persons.

A user also agrees that VEGA-GEOGLAM will use his/her e-mail address for notifications.

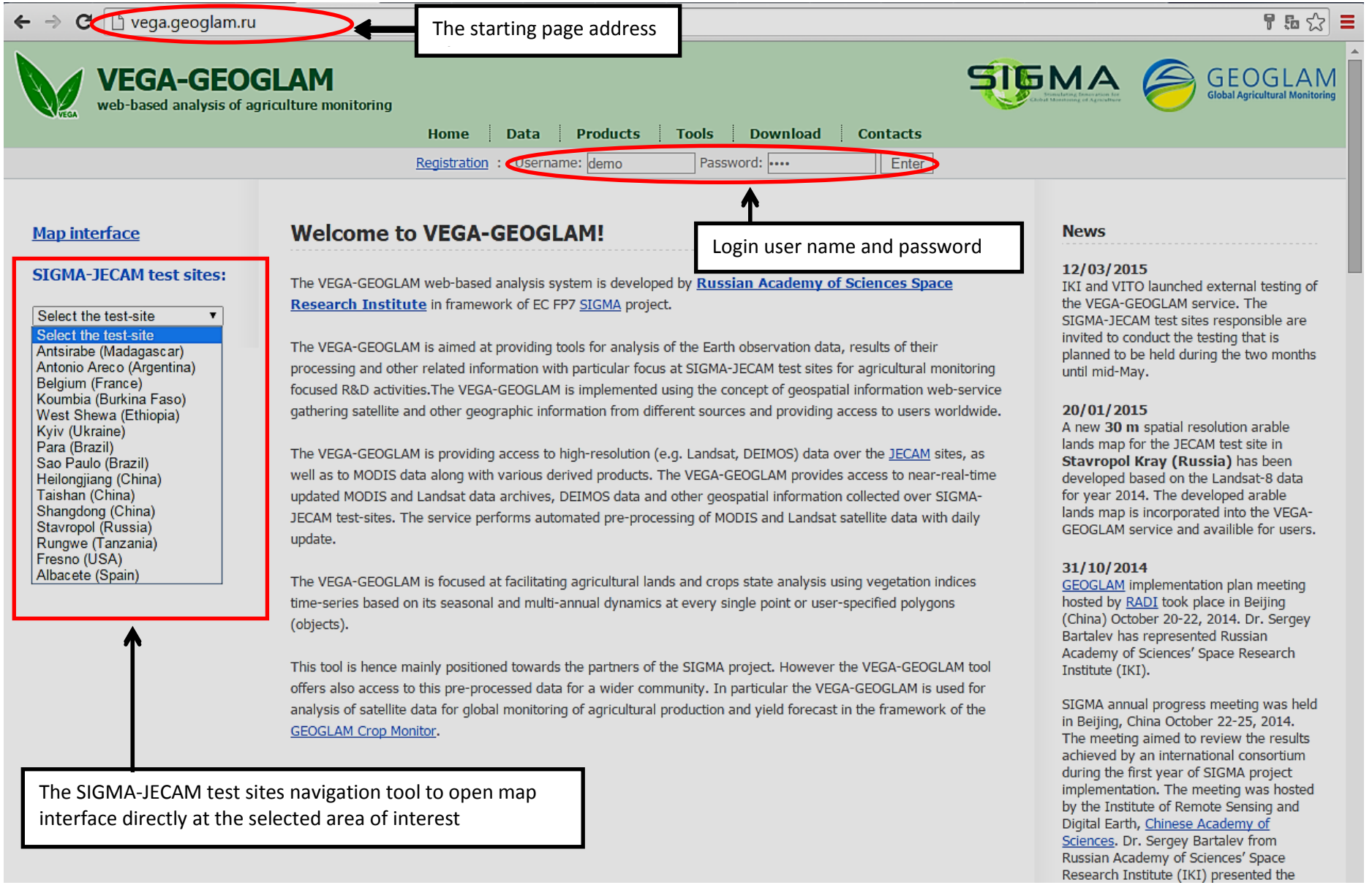
Using the VEGA-GEOGLAM you agree to the terms of data collection, storage, use and transfer. The VEGA-GEOGLAM team respects the intellectual property rights of other persons. Therefore, we require that information did not violate the intellectual property rights and other rights of the third parties. When you enter any data to the VEGA-GEOGLAM other users can view, copy and use it in their work. You also have the ability to work with data entered by other users. If

you want to send us messages, you can do it through the website by e-mail: vega_tech@smis.iki.rssi.ru



The Agreement is signed for the period of the project EC FP7 SIGMA implementation, but may be terminated by the request. In case of termination, you lose the right to access and use of the VEGA GEOGLAM. The rights of other users to utilize data you entered before the termination are remaining in force.

3. The VEGA-GEOGLAM starting page



4. The Earth observation and other data

The data to be provided through the VEGA-GEOGLAM facilities are summarized in the tables below:

EO sensor	Data	Time period covered and updating mode
MODIS	MOD09 standard product	2000 – ongoing, automatic daily download from NASA Land Processes Distributed Active Archive Center (LP DAAC) https://lpdaac.usgs.gov/about/citing_lp_daac_and_data
Landsat	Level 1T standard product	2008 – ongoing, a day of data became available, automatic download from U.S. Geological Survey (USGS) http://earthexplorer.usgs.gov/
DEIMOS	L1T orthorectified product	2010 - ongoing, download from DEIMOS as soon as data available

The MODIS and Landsat data are continuously updated over the SIGMA-JECAM test sites and entire Northern Eurasia region. The VEGA-GEOGLAM is potentially open to include other EO data, which can be provided by the SIGMA project partners and under their requests.

Data	Time period covered and updating frequency
Meteorological data (National Center for Atmospheric Research (NCEP) http://rda.ucar.edu/datasets/ds094.0/	2000 – ongoing, 4 times per day update
Field data provided by project partners for the SIGMA-JECAM test-sites	Follows data providing
National and sub-national information on agricultural statistics provided by project partners	Follows data providing

5. The EO data derived products

The data derived products, which are foreseeing to be provided through the VEGA-GEOGLAM facilities, are summarized in the tables below:

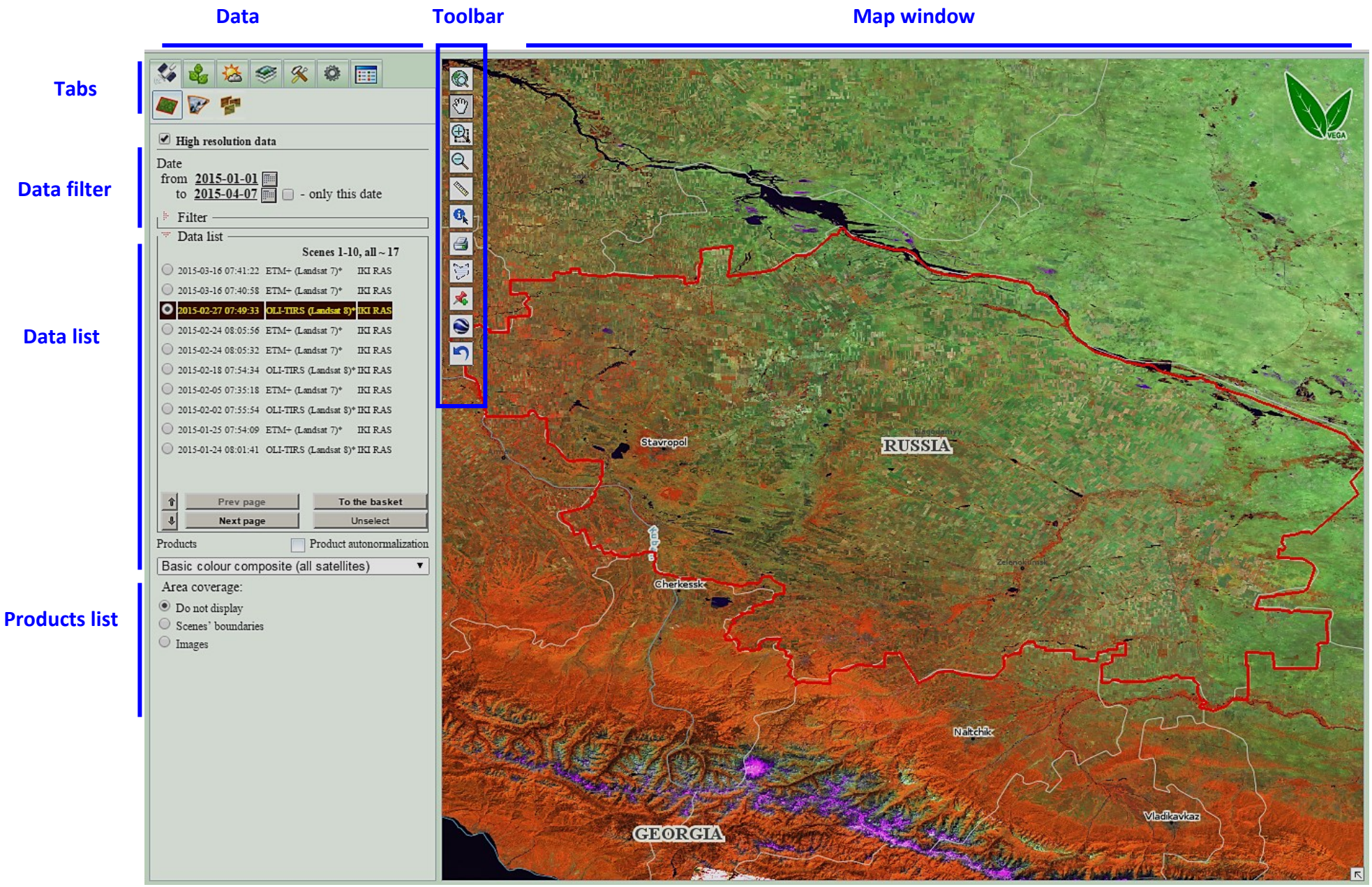
EO data product	Time period covered and updating frequency
MODIS NDVI cloud-free composites	2000 – ongoing, weekly
MODIS multi-channel image cloud-free composites [1]	2000 – ongoing, monthly
Landsat image cloud-free composites	2008 – ongoing, yearly for vegetation season
DEIMOS data derived NDVI images [2]	2010 – ongoing

EO data derived thematic product	Time period covered and updating frequency
MODIS data derived arable lands, winter crops and fallow lands masks [3]	2000 – ongoing, annualy
MODIS NDVI seasonal anomalies for agricultural lands and crops [4]	2000 – ongoing, weekly

The VEGA-GEOGLAM will include global and regional EO data derived products, which are foreseeing to be developed within the SIGMA project, as well as the SIGMA-JECAM test-sites available thematic maps, which can be provided by the SIGMA project partners and under their requests.

[1] Available for test sites in Russia, Ukraine and China.
[2] In progress.
[3] Limited to the Russian Federation with possible extension to other regions if suitable.
[4] Aggregated at the level of administrative districts, limited to the Russian Federation with possible extension to other regions if suitable.

6. The main elements of the map interface

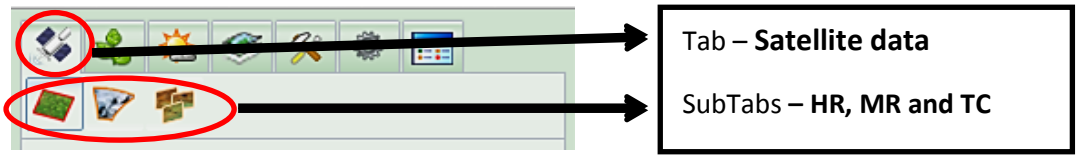


7. Toolbar description

- Full extent
- Pan (Screen moving)
- Zoom in
- Zoom out
- Distance measurement
- Infoclick
- Print (save active screen as an image file)
- Poligon drawing
- Add point object
- View in the Google Earth (Make kmz. file from active screen) and open it in the GE
- Back

8. Group of the Tabs - Satellite data - This part of the VEGA-GEOGLAM interface provide access to integrated archive of satellite images acquired by different instruments. A user can work with data online or download data to user's desktop computer. Interface provides access to data of the following satellite instruments: NOAA-AVHRR, MODIS-Terra/Aqua, Meteor-M1, Kanopus, Landsat, Deimos and some others. Satellite data are available for the period from 1984 up to now.

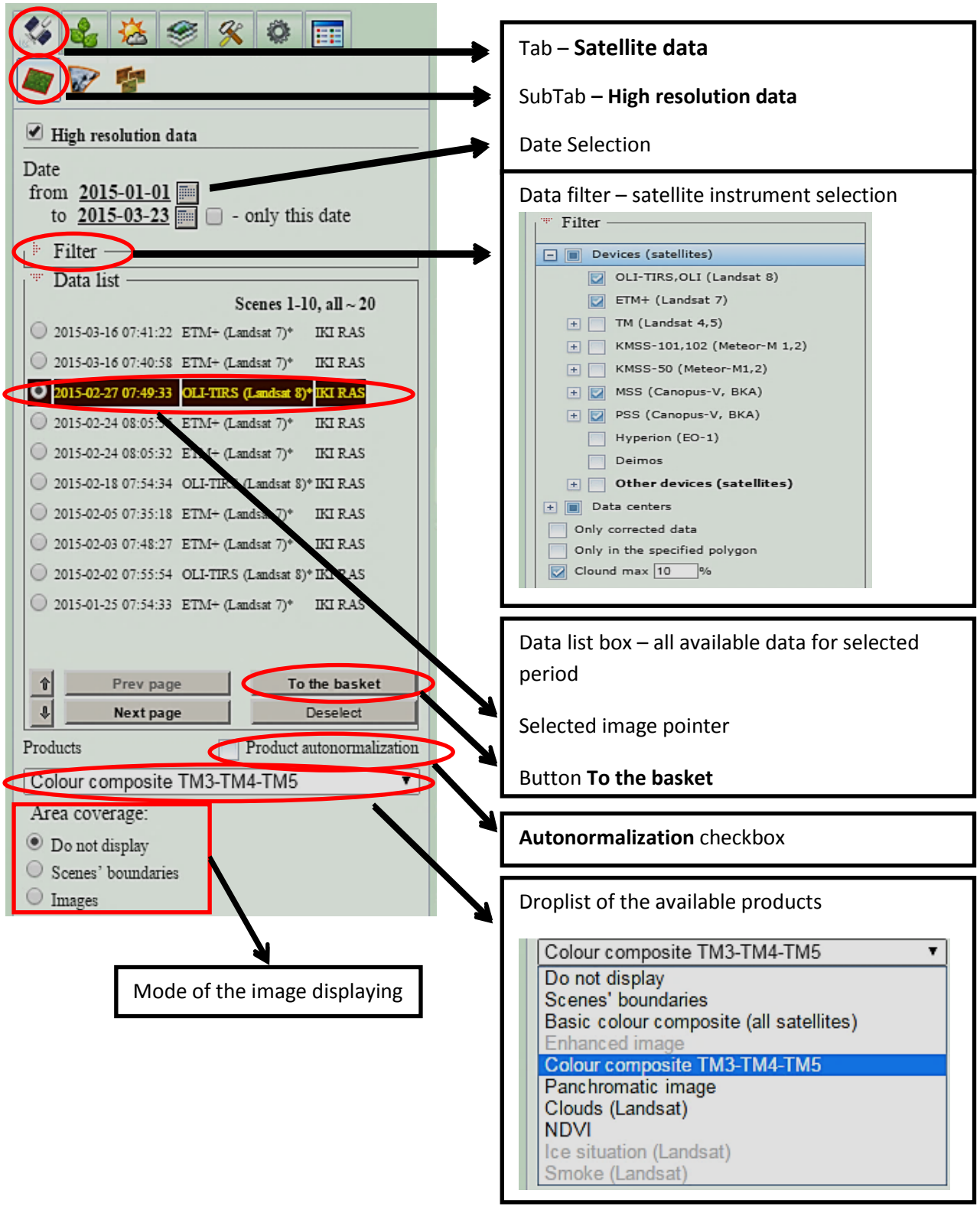
Group of the Tabs - Satellite data consists of three parts: **High resolution (HR), Moderate resolution (MR), Temporal composite images (TC).**



8.1 High resolution data include images from following satellite systems:

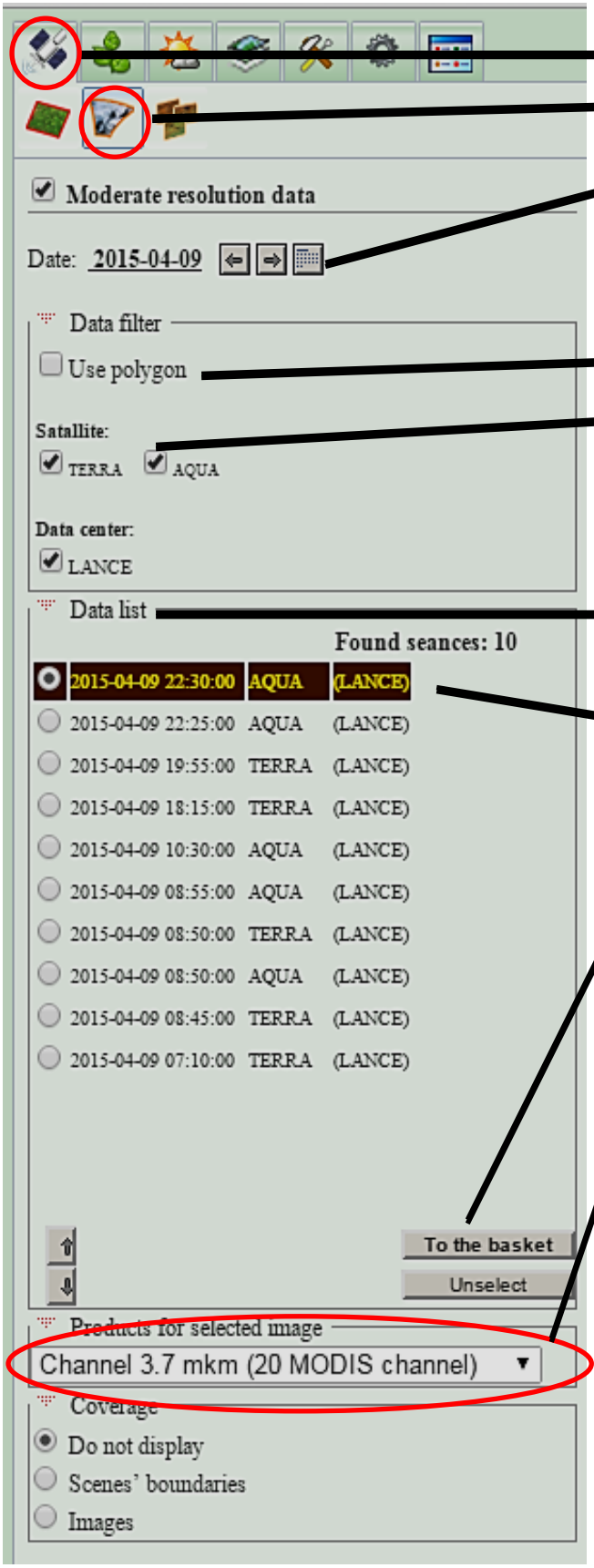
- Landsat 4, 5, 7, 8
- Kanopus-B
- METEOR-M1-KMSS
- Kanopus-PSS, Kanopus-MSS (Roskosmos)
- Deimos

Note: Using **the HR data tab** we recommend to switch off **MR data** and **TC** tabs.



8.2 Moderate resolution data archive of images acquired by the NOAA-AVHRR, MODIS-Terra/Aqua, MSU-MR and NPP satellite instruments are accessible via this tab.

Note: Using **the MR data tab** we recommend to switch off **HR data** and **TC** tabs.



Tab – **Satellite data**

SubTab – **Moderate resolution**

Date Selection

Use AOI (polygon) to select images

Select satellite TERRA or AQUA

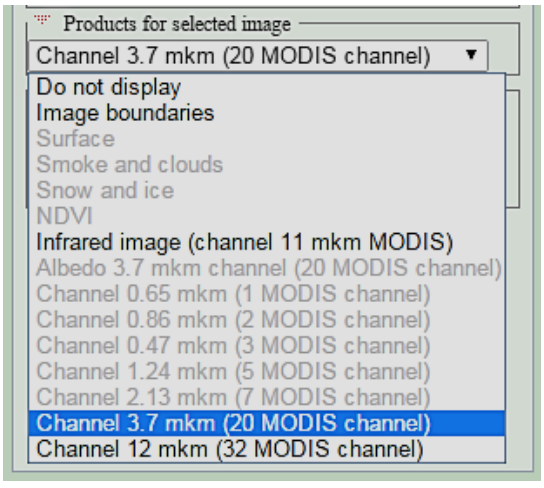
Button **To the basket**

Data list box – all available data for the selected period

Selected image pointer

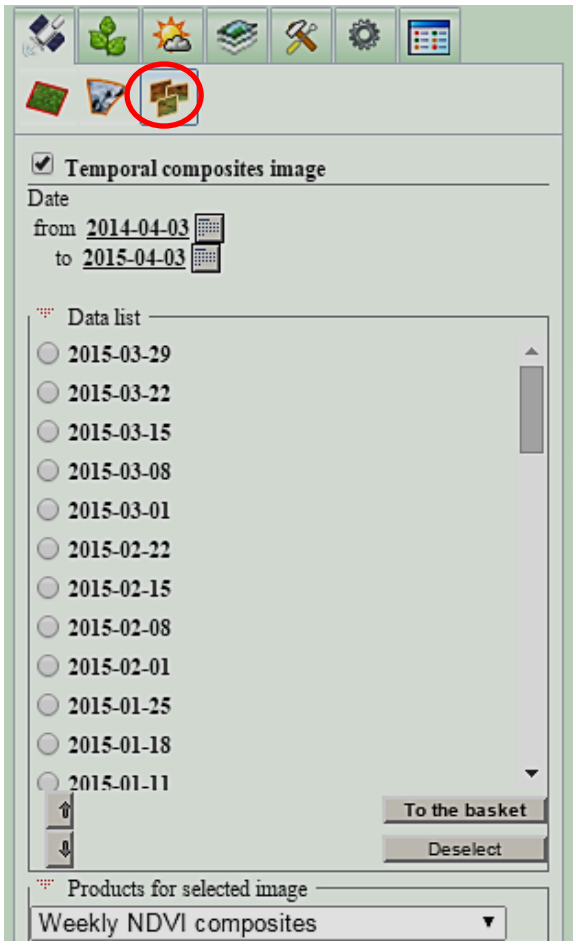
Button **To the basket**

Available data products

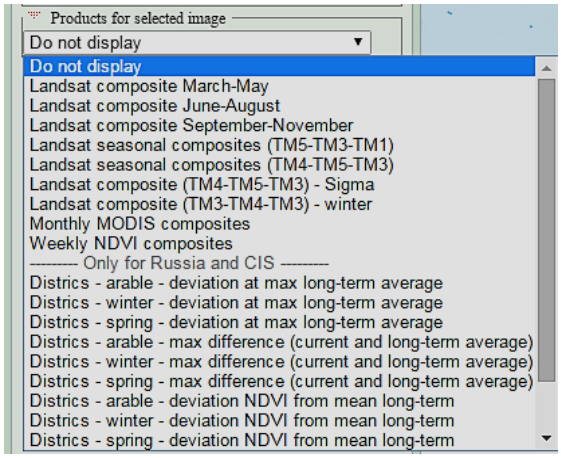


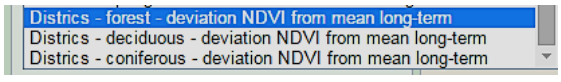
8.3 Temporal composite images - enhancement multi-temporal (seasonal) cloud free composite images. The map interface provides access to Landsat and MODIS data derived composite images along with MODIS derived NDVI composite images.

Note: Using **TC data products tab** we recommend to switch off **HR** and **MR data** tabs.

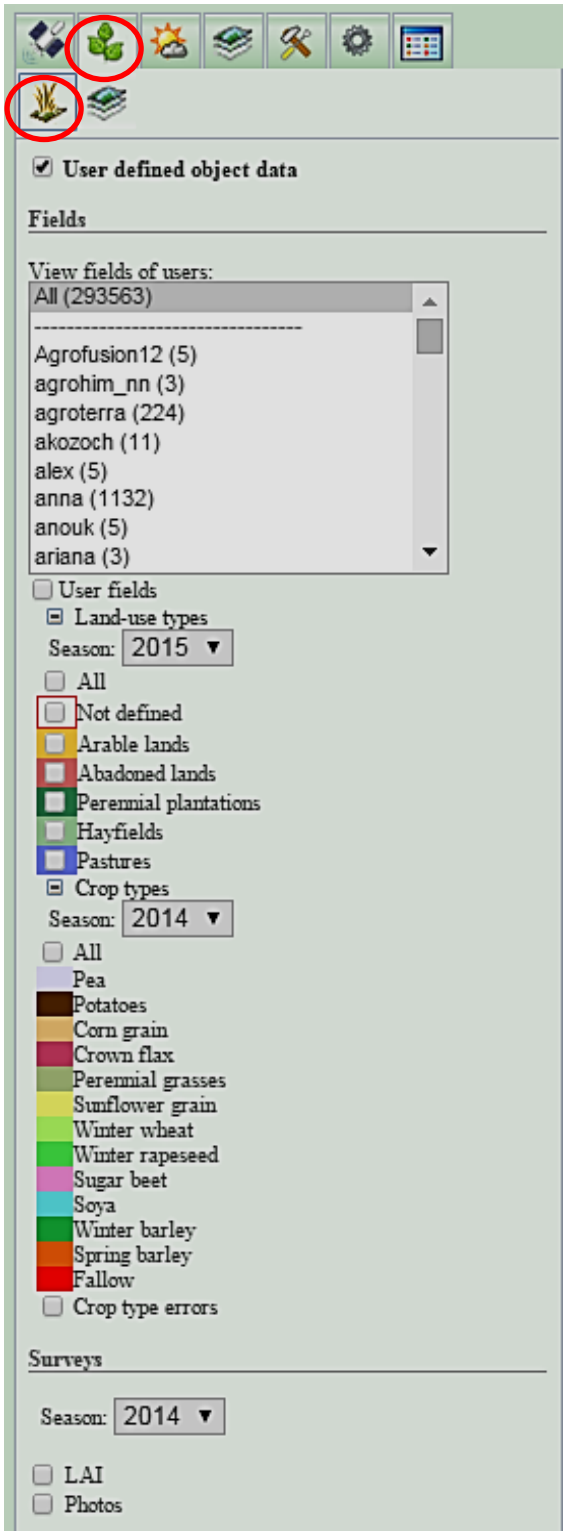


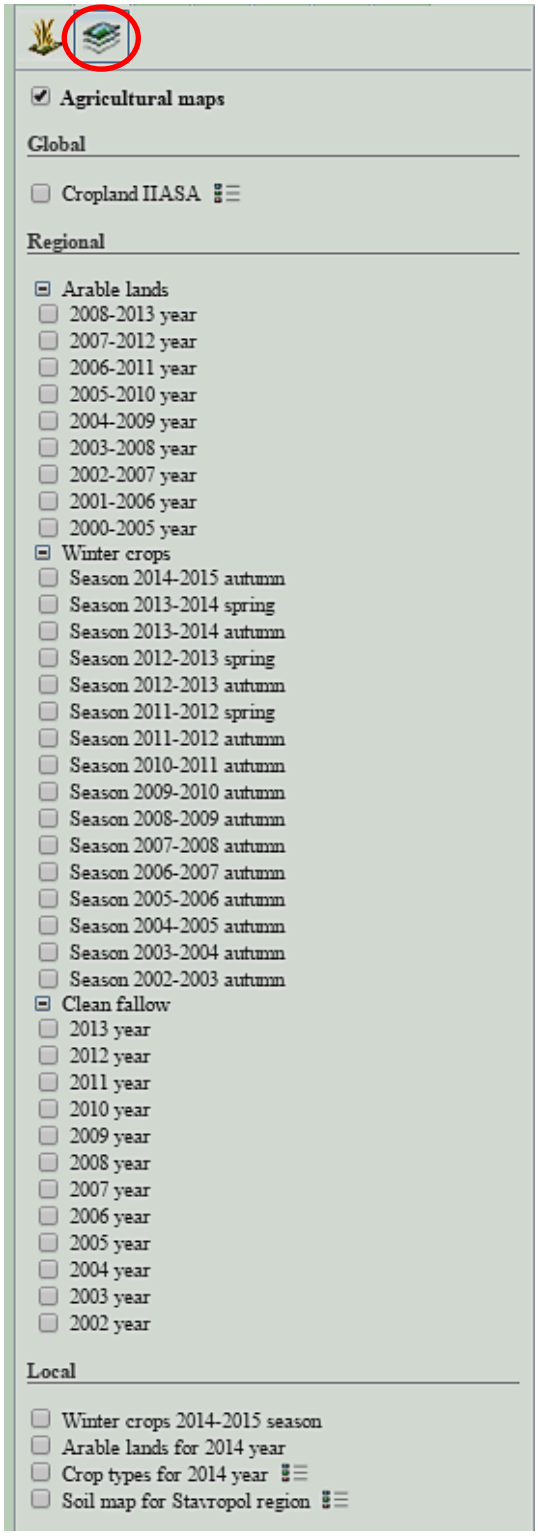
The list of available composite images



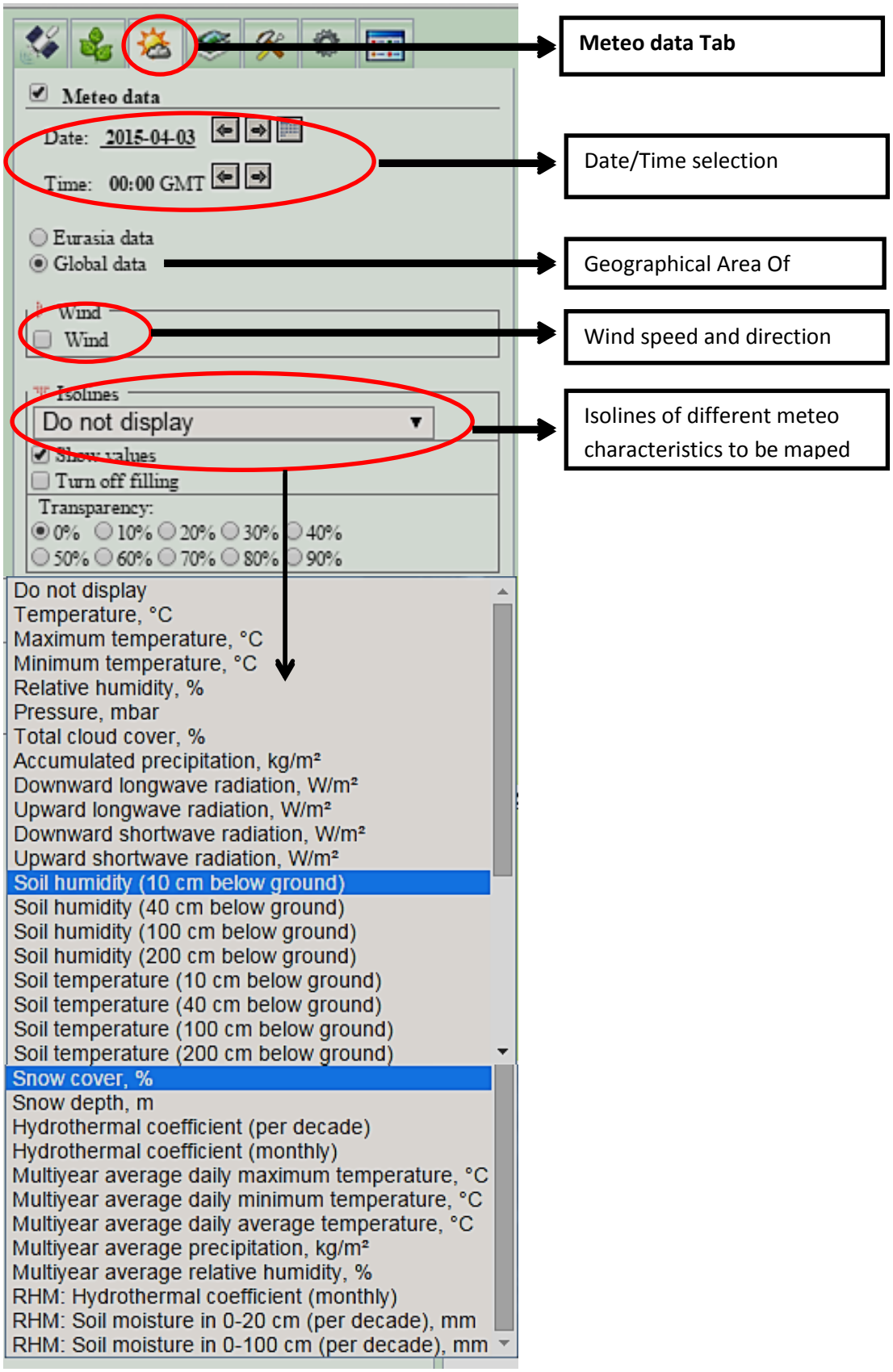


9. Group of the Tabs - Agricultural data provides access to the data on agriculture lands and crops. The subTab **User defined object data** allows visualising objects boundaries (polygons) and corresponding land-use and crop types maps based on objects' related attributes. The land-use maps legend consist of 6 classes, such as arable lands, abandoned lands, perennial plantations, hayfields and pasture. This object creation and editing procedure described in the **Polygon drawing** section of this User Guide (section 16, page 24). The subTab **Agriculture maps** provides access to the set of annually updated maps, such as: arable lands, winter crops, clean fallow.





10. Meteo data Tab provides access to actual and historical weather data, such as air temperature, wind speed, atmospheric pressure, cloud cover, soil humidity and temperature (at different deep levels) and some others.



11. Group of the Tabs - Basic maps – consists of two subtabs: **Base maps** and **Land cover maps**.

11.1 Base maps it is a very basic cartographic vector layers to be mapped using the interface along with the Sigma-JECAM test-sites limits.

11.2 Land cover maps – annually (from year 2000) updated MODIS derived maps with the legend of 21 land cover classes

12. Group of the Tabs - Data Analysis - this interface part provides various tools with focus on following functions: (1) Image color enhancement, (2) Image Classification and (3) Image Algebra (mathematical operations with images). The rest tools in the tab serve as auxiliary ones. The **Data Analysis** Tab functions meanings are illustrated below.

Tab – **Data Analysis**

Basket - making images available for further analysis and processing

Image color enhancement – visual image improvement based on multi-channel (multi-spectral or multi-temporal or multi-sensor) colour RGB compositing and histograms transforming

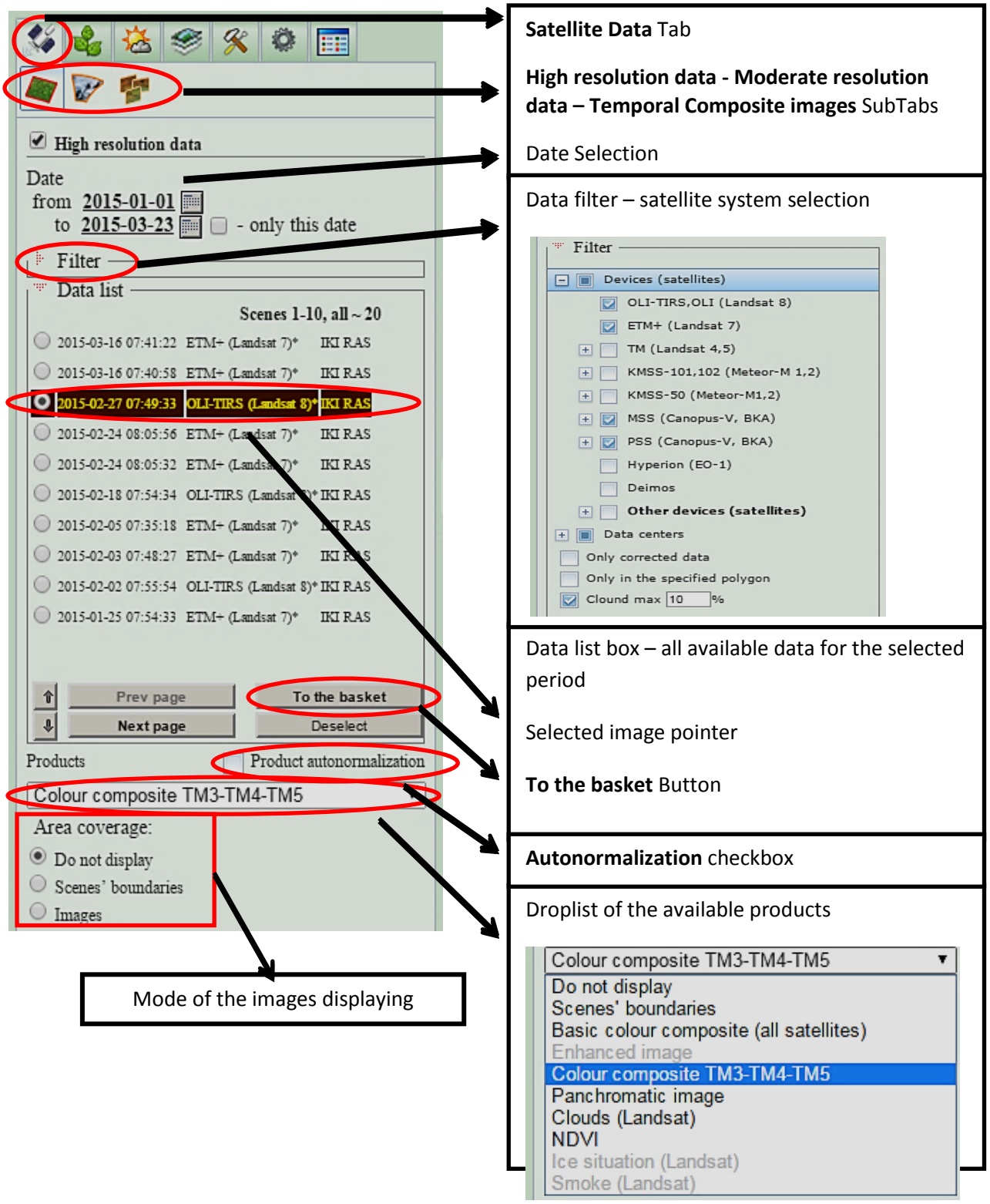
Point objects collection of the signatures for classification. Access to spectral or temporal profiles at the points

Classifications - thematic classification of raster images

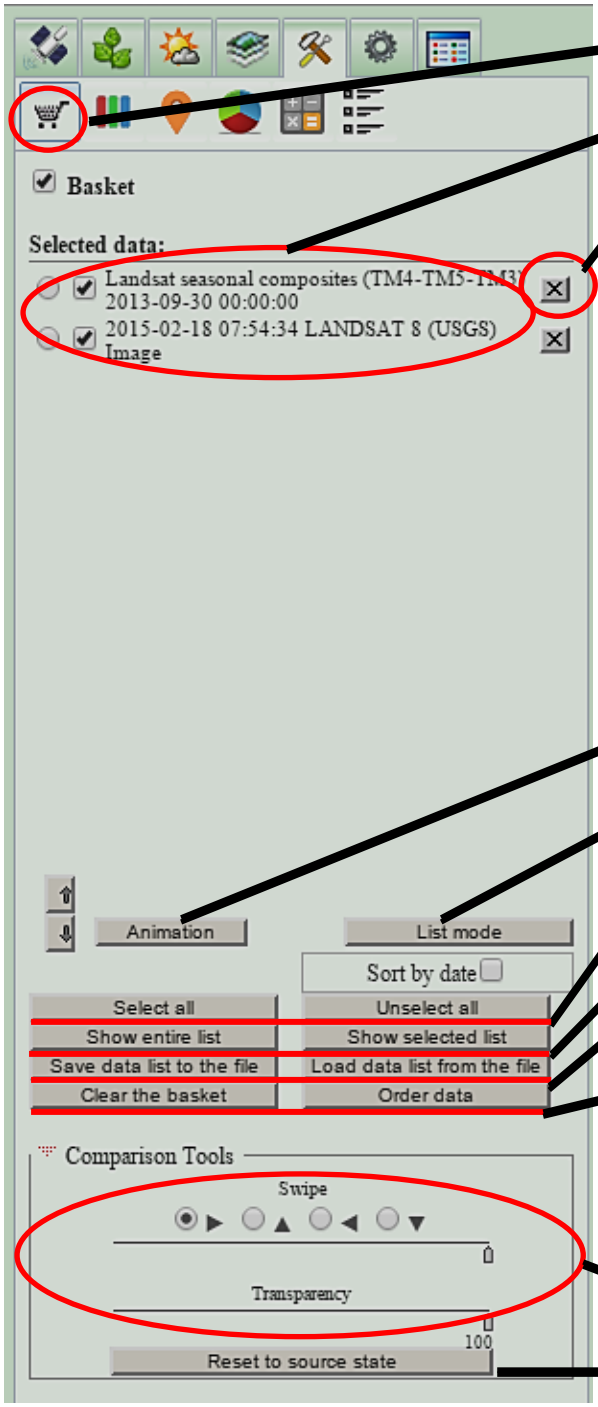
Image algebra - mathematical operations with images

Bands selection should be done before any classification

12.1 Basket. This tool allows making images available for further analysis and processing. This tab requires describing in linkages with Group of the Tabs - **Satellite data.** Any type of the images from the **Satellite data Tabs** (High Resolution, Moderate Resolution or Temporal Composite images) could be made available for analysis and processing by their selection and use **To the basket** button. The data selected appear in the tab **Basket**, described below.



Basket – in this tab user could have available data that have been selected before (either individual images or temporal composites)



Basket SubTab

Data available for the analysis and processing

Data removing button

Automatic images animation

List mode

Images selection

Show list of images in the interface

Save/Load selected data to/from the list (txt. file)

Order data for downloading

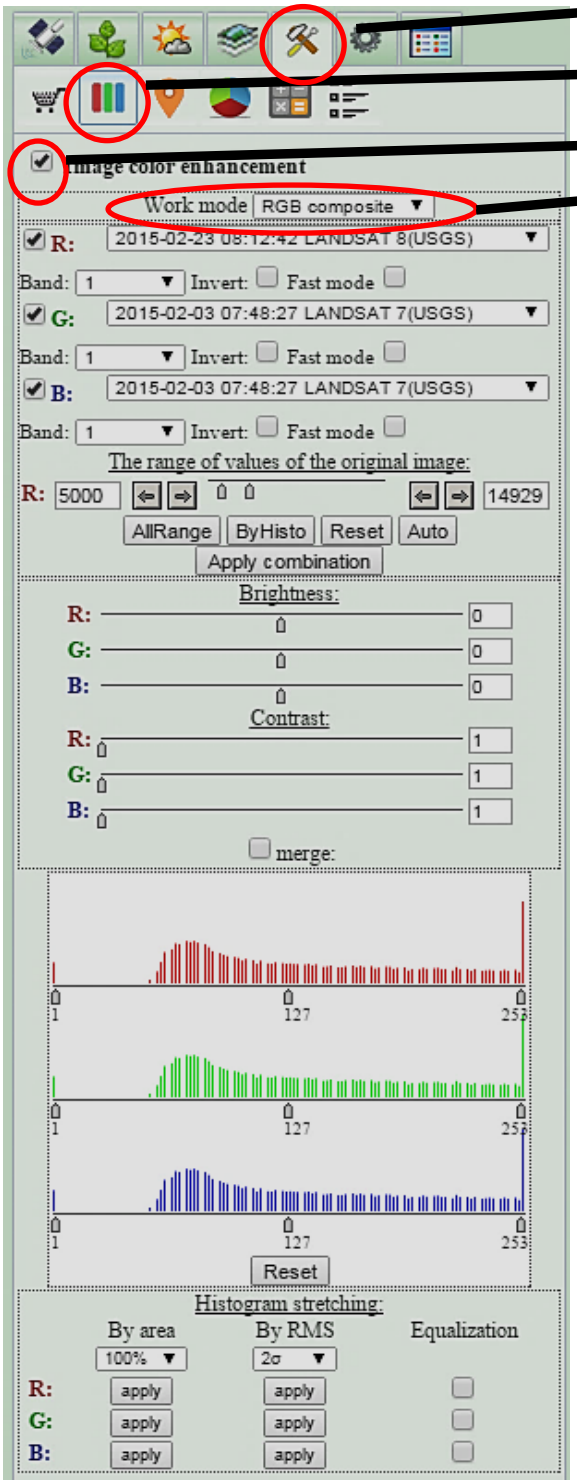
Clear basket – removing all data from basket

Comparison Tools – swipe and transparency

Reset all settings in the comparison tools

12.2 Image color enhancement - a set of tools that allows following options:

- RGB colour compositing of multi-spectral, multi-temporal or multi-sensor satellite images;
- Transformation of image histograms to facilitate visual interpretation



Data Analysis Tab

Image color enhancement SubTab

Switch Tab

Mode selection (RGB or Monochrome)

Band selection (*inside* Image color enhancement tab). It is possible to choose the same or different images in the bands R, G, B. After selection it is necessary to push **Apply combination** button.

Range of values for the 16-bit data in each channel. Option appear only for unsigned integer 16-bit data

Brightness / contrast scales

Image histograme scales

Image histogram stretching

1) By area of the histogram (80%,90%,95%,98%,100%)

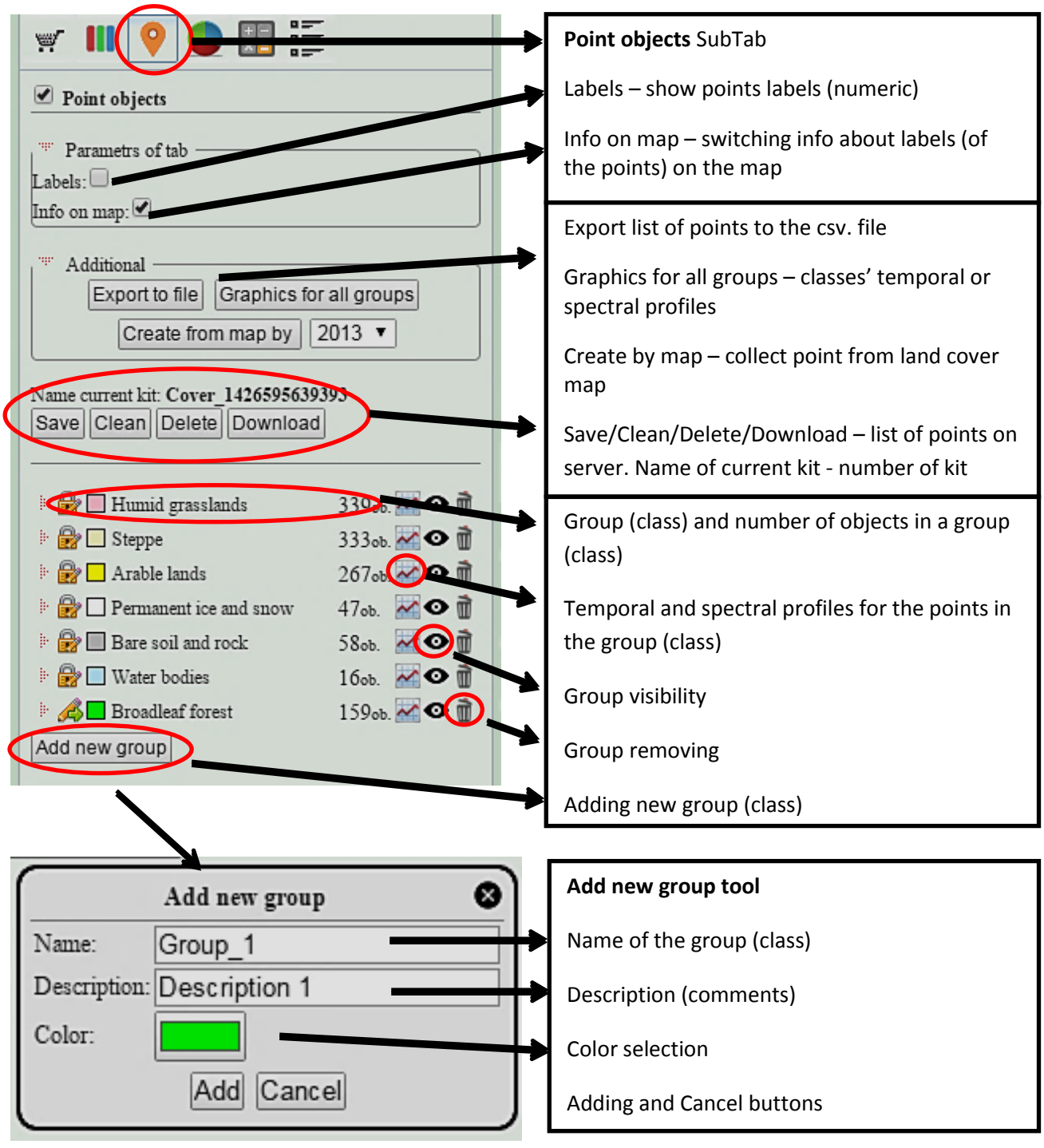
2) By RMS error (1σ, 1.5 σ, 2σ, 2.5σ, 3σ)

3) Equalization - Histogram equalization is a technique for adjusting image intensities to enhance contrast.

12.3 Point objects. This option provides possibility for signature collection to perform supervised classification. It is possible to use option **create by map** or make it manually by adding new groups of points.

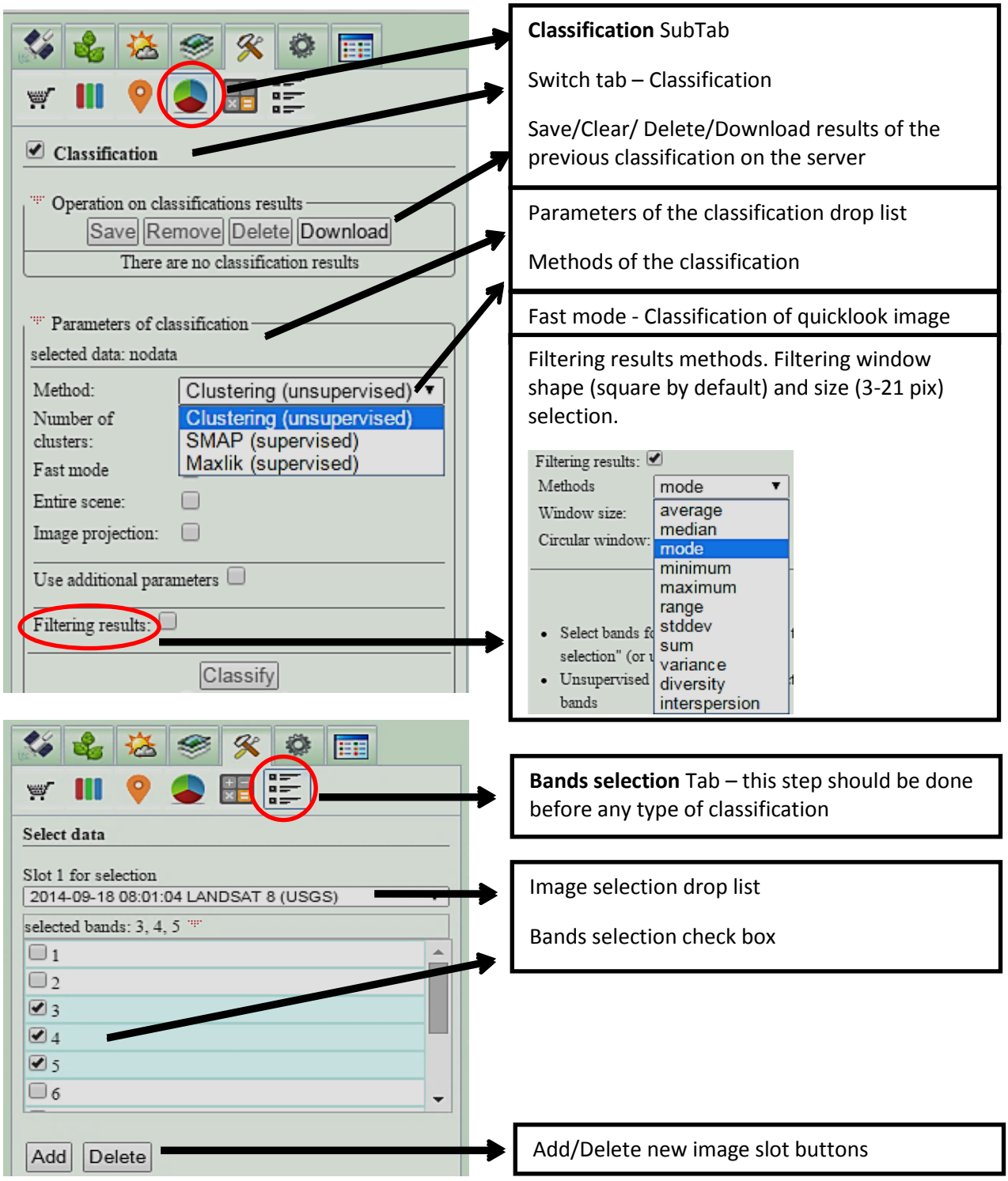
It allows to the user to mark objects and to add comments. Points could be grouped together to groups (classes).

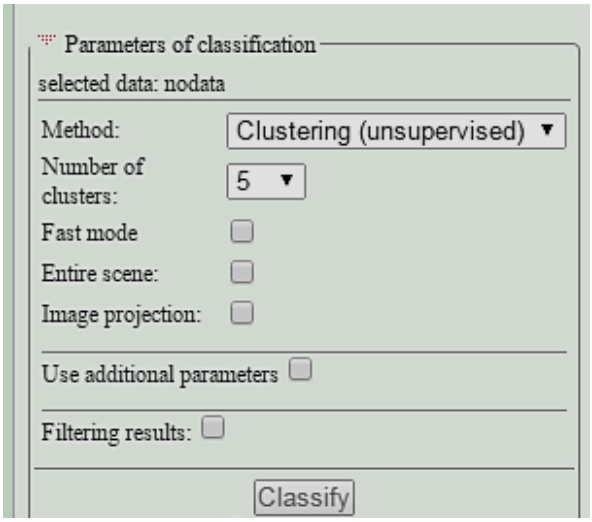
The tab is divided into the following areas: options to collect points and tool to work with the current set of points.



12.4 Classification and Bands Selection Tabs - thematic interpretation of the multi-band raster images. The classification methods available in the interface are based on the open source GRASS modules. There are three different methods of the classification in the web-interface:

1) Clustering (unsupervised)
2) SMAP (supervised)
3) Maxlik (supervised)

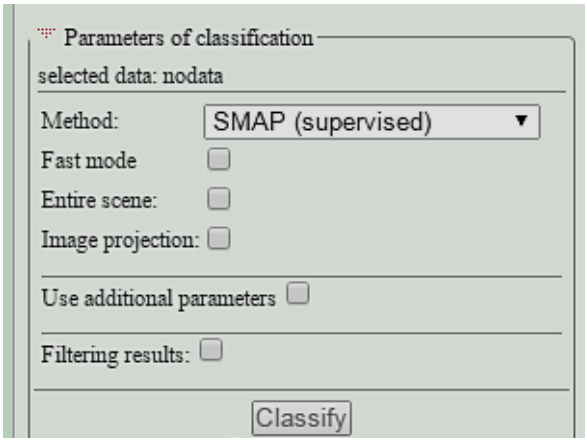




Clustering - unsupervised classification

Preprocessing – Generates spectral signatures for land cover types in an image using a clustering algorithm (i.cluster - method description http://grass.osgeo.org/grass64/manuals/i.cluster.html)

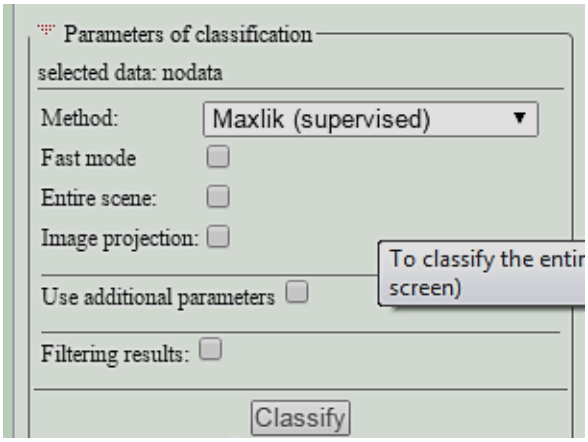
Classification – Classifies the cell spectral reflectances in imagery data. Classification is based on the spectral signature information generated by either i.cluster, (i.maxlik - method description http://grass.osgeo.org/grass64/manuals/i.maxlik.html)



SMAP Performs contextual (image segmentation) image classification using sequential maximum a posteriori (SMAP) estimation.

Preprocessing - (using training maps) - Generate statistics for i.smap from raster map layer. (i.gensigset - method description http://grass.osgeo.org/grass64/manuals/i.gensigset.html

Classification - Performs contextual (image segmentation) image classification using sequential maximum a posteriori (SMAP) estimation. (i.smap - method description http://grass.osgeo.org/grass64/manuals/i.smap.html)



Maxlik – (SMAP flam m) Performs contextual (image segmentation) image classification using sequential maximum a posteriori (SMAP) estimation.

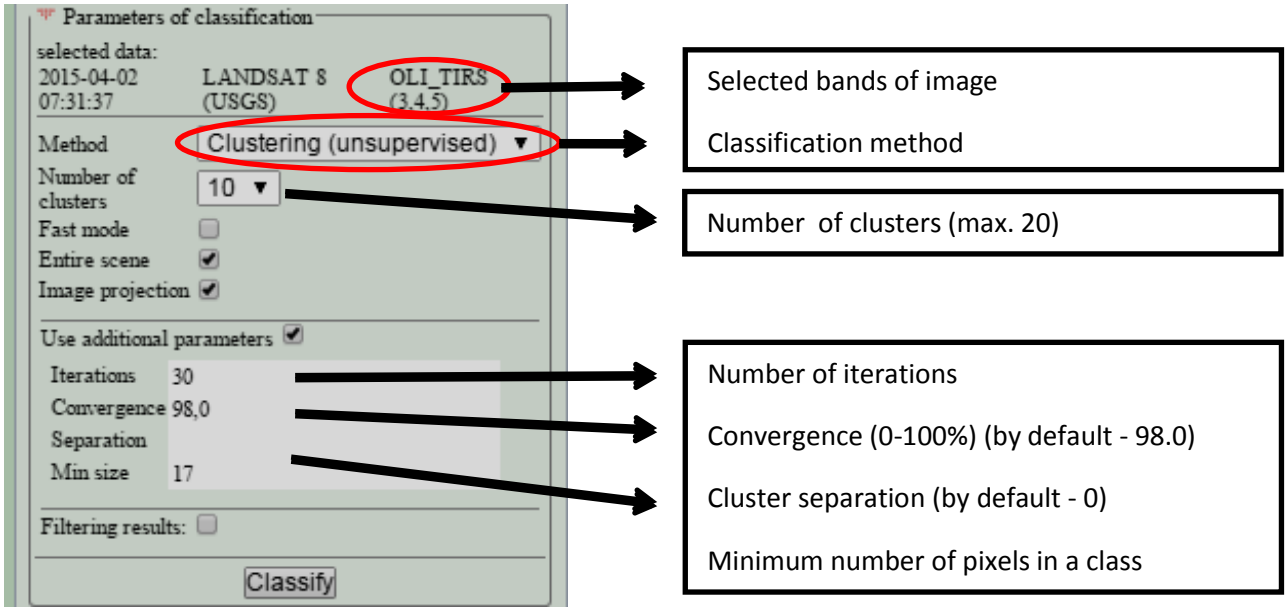
Preprocessing - (using training maps) - Generate statistics for i.smap from raster map layer. (i.gensigset - method description http://grass.osgeo.org/grass64/manuals/i.gensigset.html

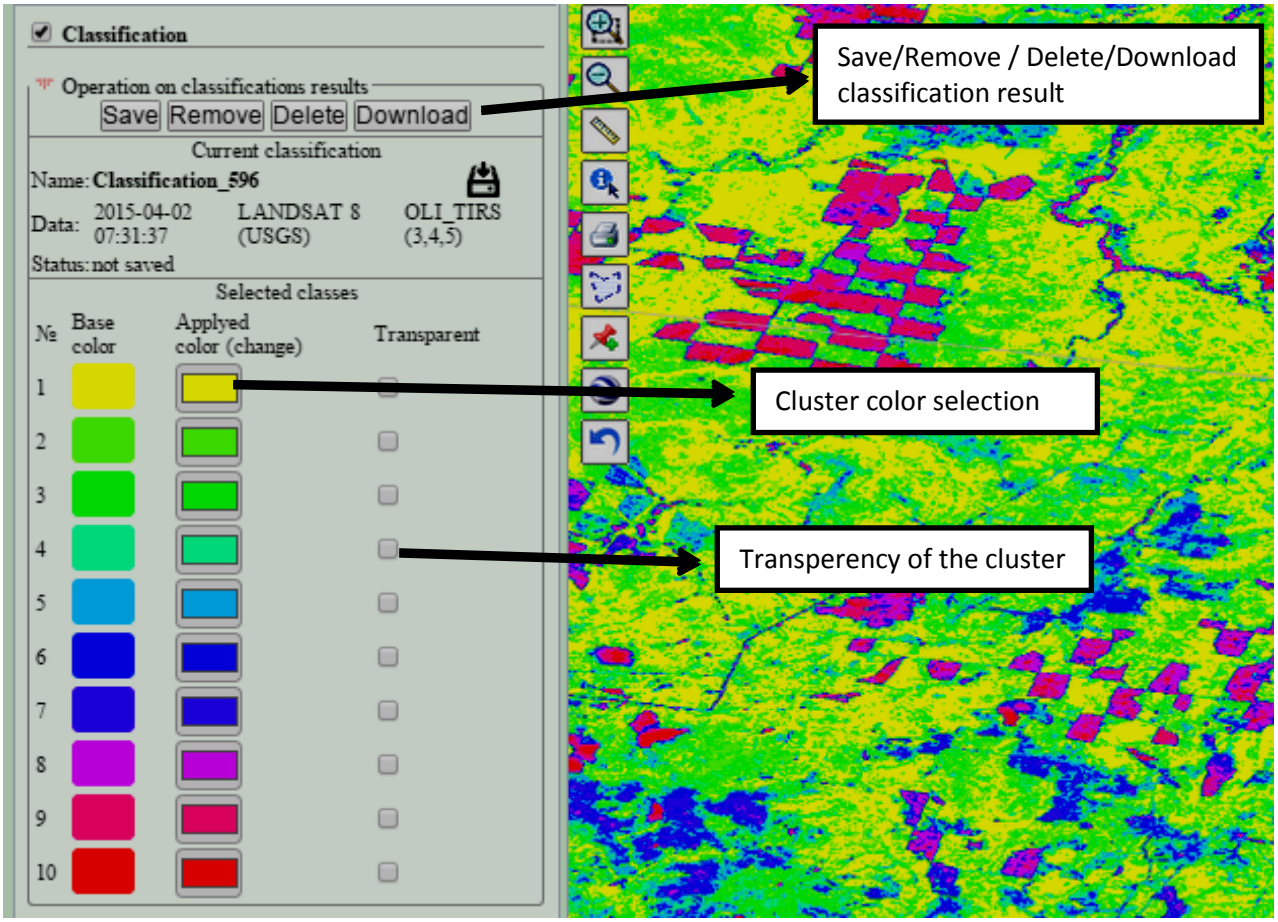
Classification - Performs contextual (image segmentation) image classification using sequential maximum a posteriori (SMAP) estimation. (i.smap - method description http://grass.osgeo.org/grass64/manuals/i.smap.html

Flag m - Use maximum likelihood estimation (instead of smap)

12.4.1 Unsupervised classification

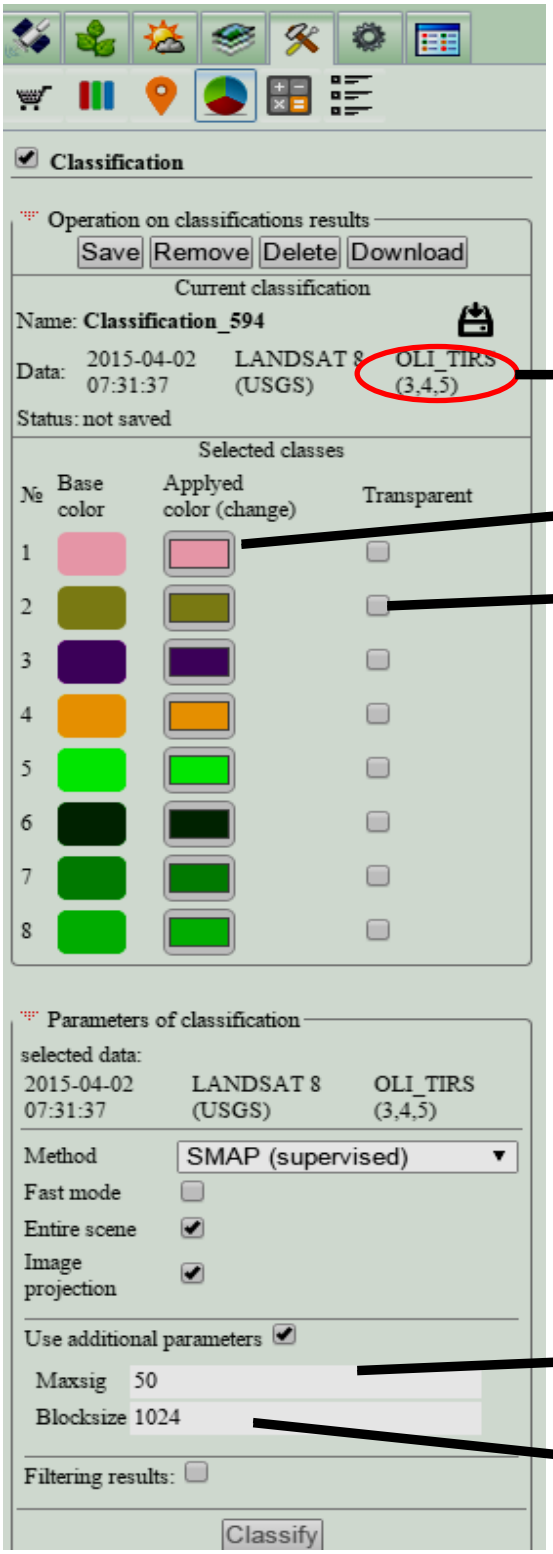
Grass module i.cluster - Generates spectral signatures for land cover types in an image using a clustering algorithm http://grass.osgeo.org/grass64/manuals/i.cluster.html





12.4.2 Supervised SMAP and Maxlik classifications

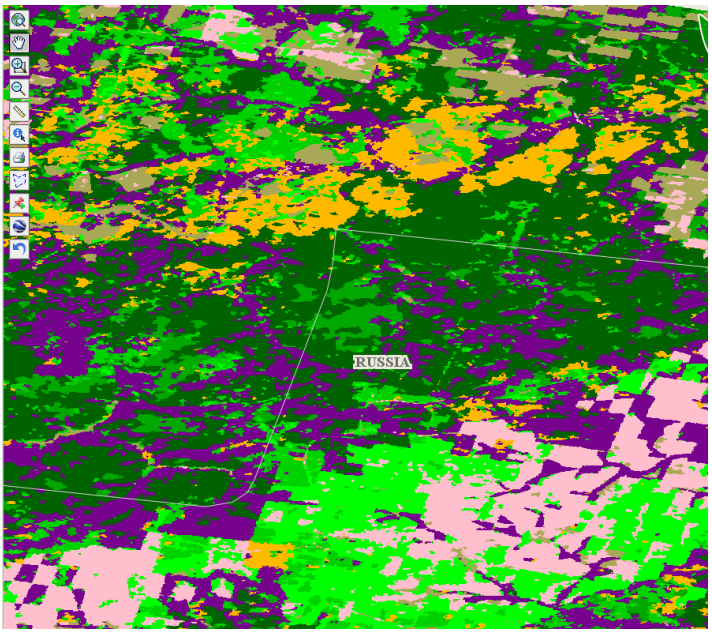
An image supervised classification methods requires collection of points (signatures) (see 12.3 Points collection). Then users have to select one of the supervised methods SMAP or Maxlik. The tools for both supervised classfication methods are similar. The SMAP method tools are discribed below.



Selected bands (bands has to be selected in the special Tab)

Class color selection

Class transperency



Max number of signatures for the class

Block size to be processed

12.5 Image Algebra - this function allows mathematical operations with images or image bands. For example, this tool allows calculating spectral vegetation indexes (NDVI, SWVI, NDSI and etc) or performing other calculations between images' bands.

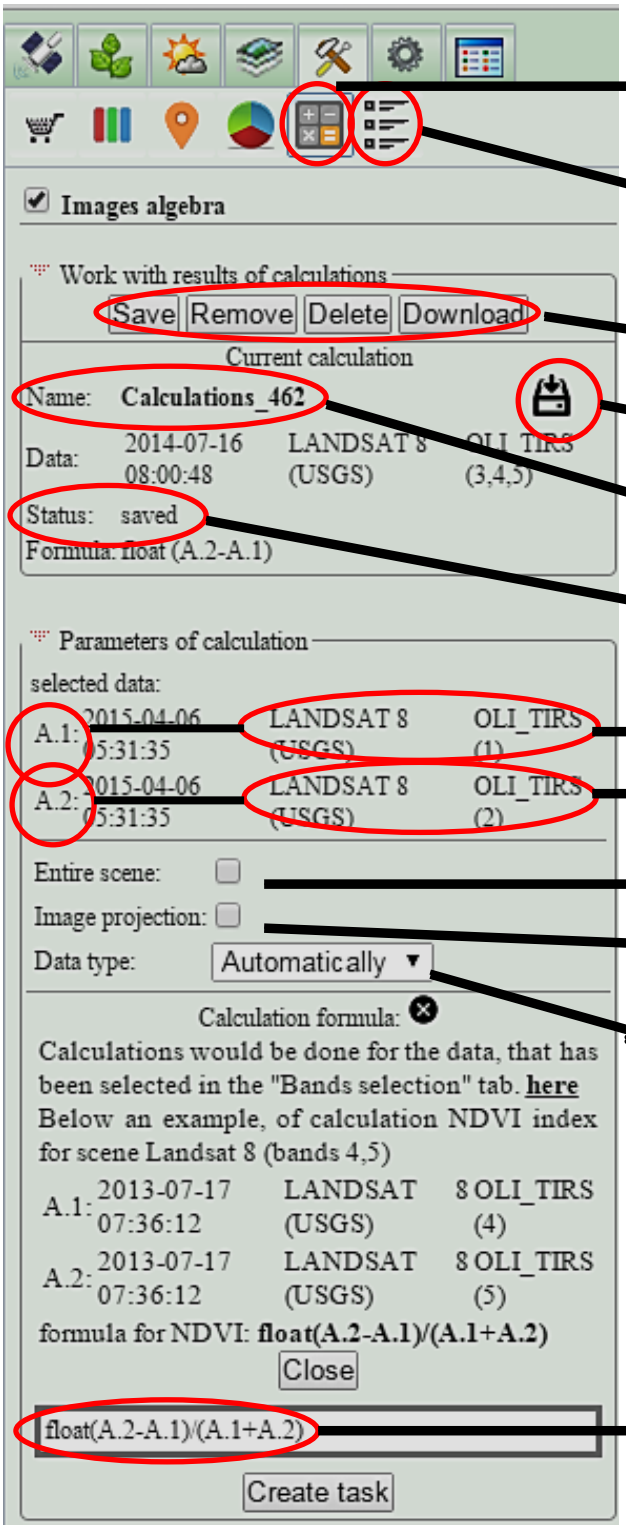


Image Algebra SubTab

Bands selection Tab – this step should be done before any type of classification. See page 21.

Save/Clear/Delete/Download results of the calculation

Saving calculations results as GeoTIFF

Name of the calculation for the downloading from the server

Saving status check

A.1 – symbol of the band 4 (Landsat 8)

A.2 – symbol of the band 5 (Landsat 8)

All scene or part of it in the frame of screen

Data or interface projection

Data type – for ex.: Byte, Int 16, Float 32 etc.

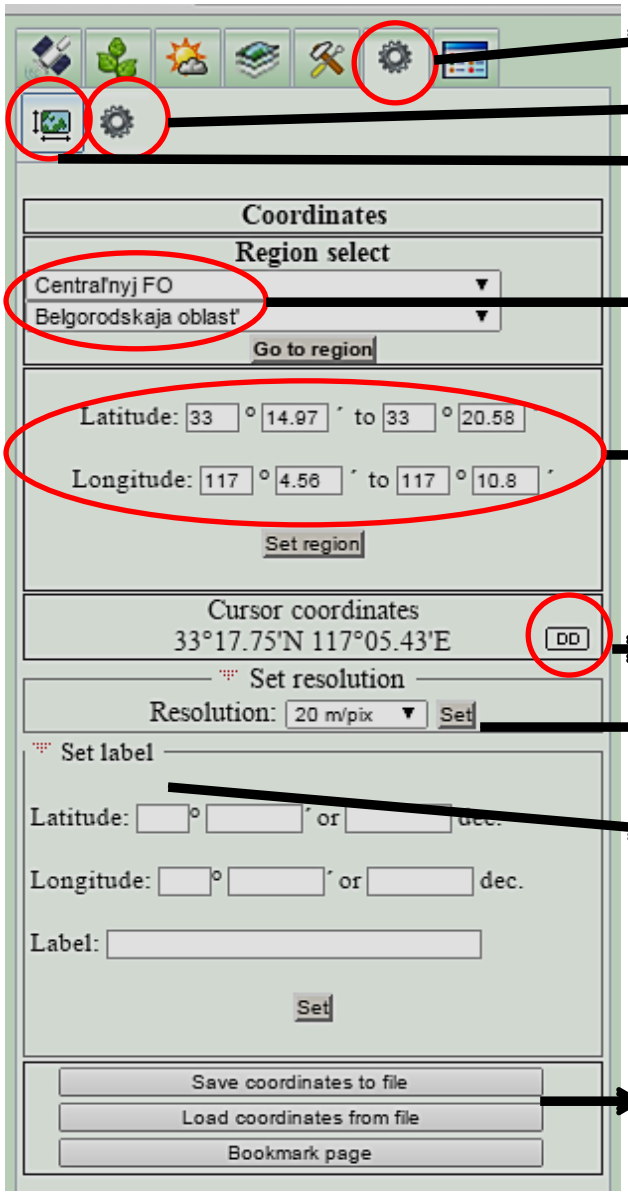
A.1 – symbol of the band 4 (Landsat 8)

A.2 – symbol of the band 5 (Landsat 8)

To calculate NDVI you have to write formula float (A.2-A.1)/(A.1+A.2) and push **Create task** button

13. Group of the Tabs - Geographical Navigation and Reprojection

By the default the interface works in the Geographic projection (Lat/Long) on the spheroid WGS 84. There is possibility to reproject interface to the Mercator.



Geographical Navigation and Reprojection Tab

Interface parameters (projection) subTab

Coordinates subTab

Region selection – Move directly to selected region (for Russia only)

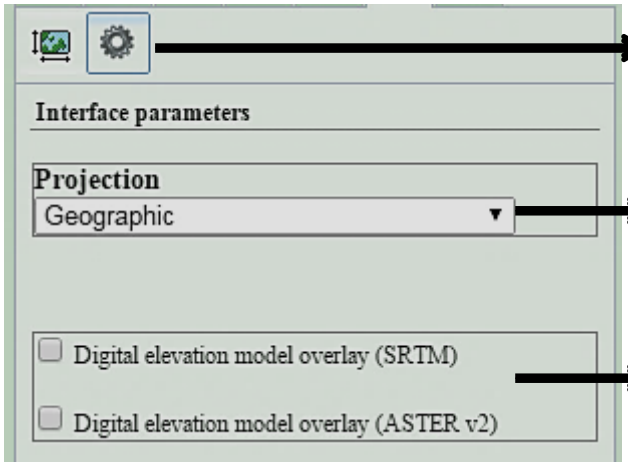
Coordinates (lat/long) – possibility to move directly to indicated geographical window

Cursor coordinates (degrees minutes seconds or decimal degrees changes by pushing button)

Resolution settings 20 or 500 m/pix

Labeling of the coordinate – input coordinates and labels it on map

Saving coordinates to ASCII file and loading from ASCII file



Interface parameters (projection) subTab

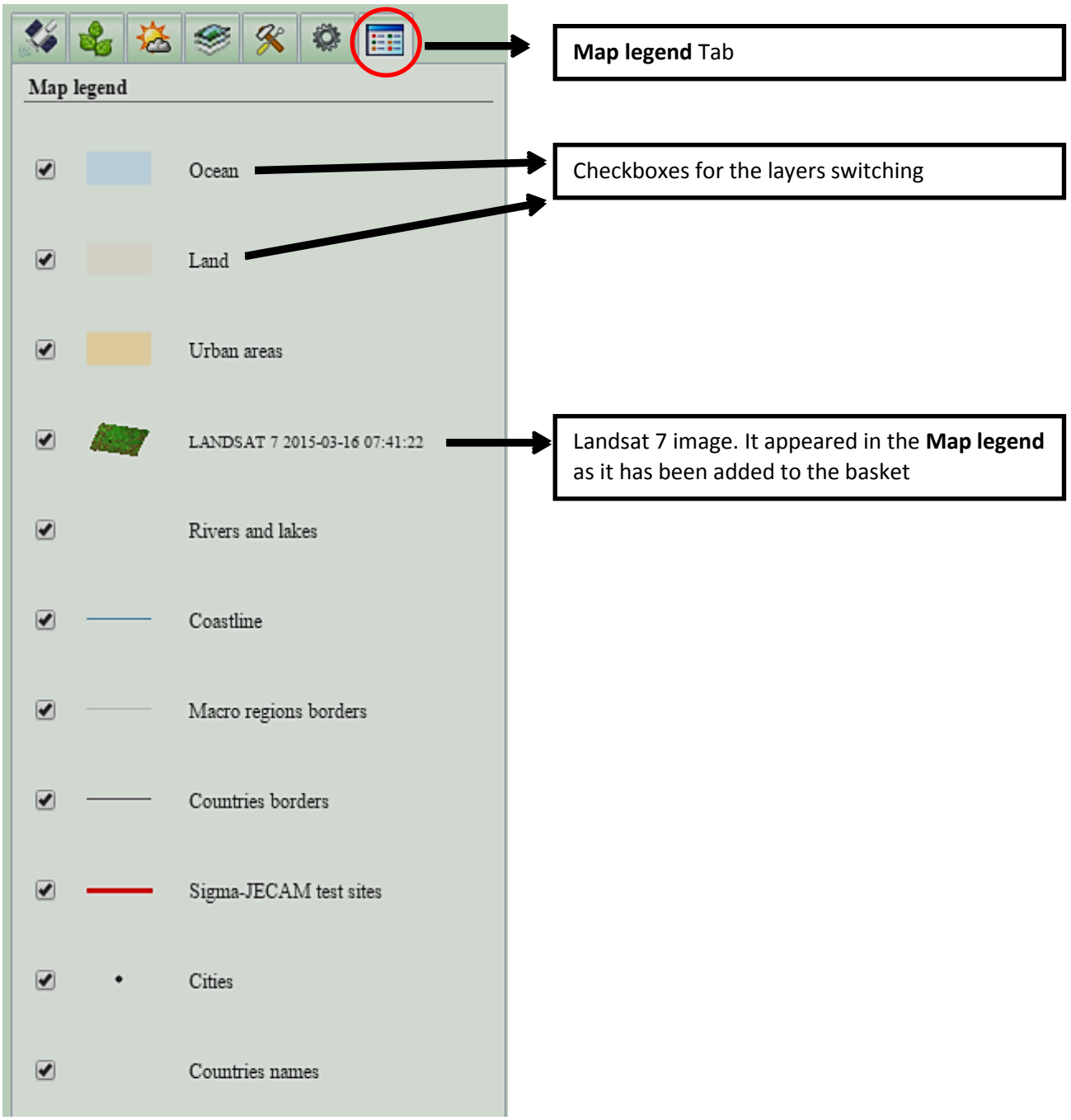
Setting map projection – Geographic or Mercator

Digital elevation model overlaying SRTM or ASTER

14. Map legend tab aimed to switch (on\off) any considered layer.

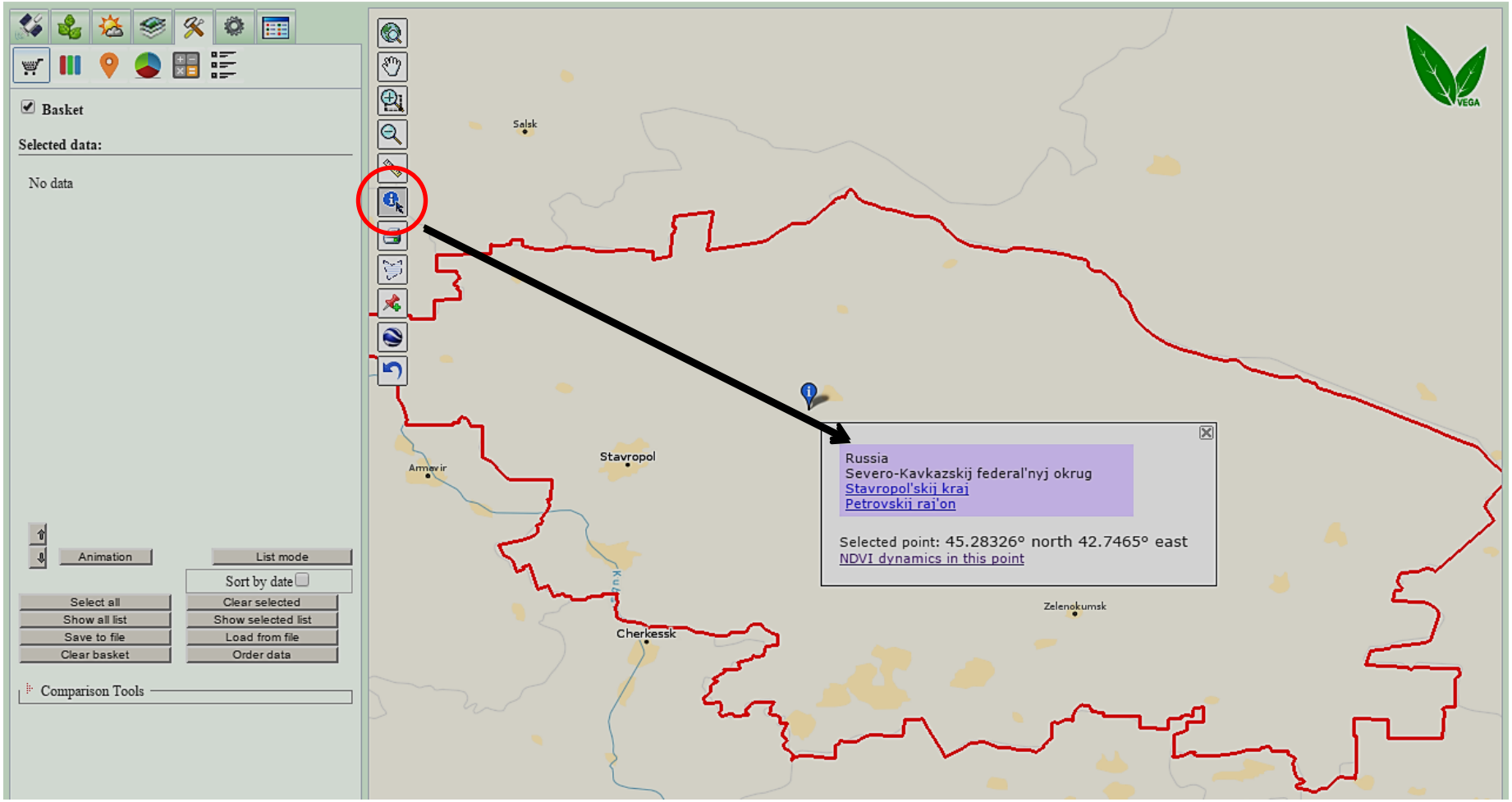
Note: if you add an image (or any kind of data) to the basket it will appear in this tab as well.

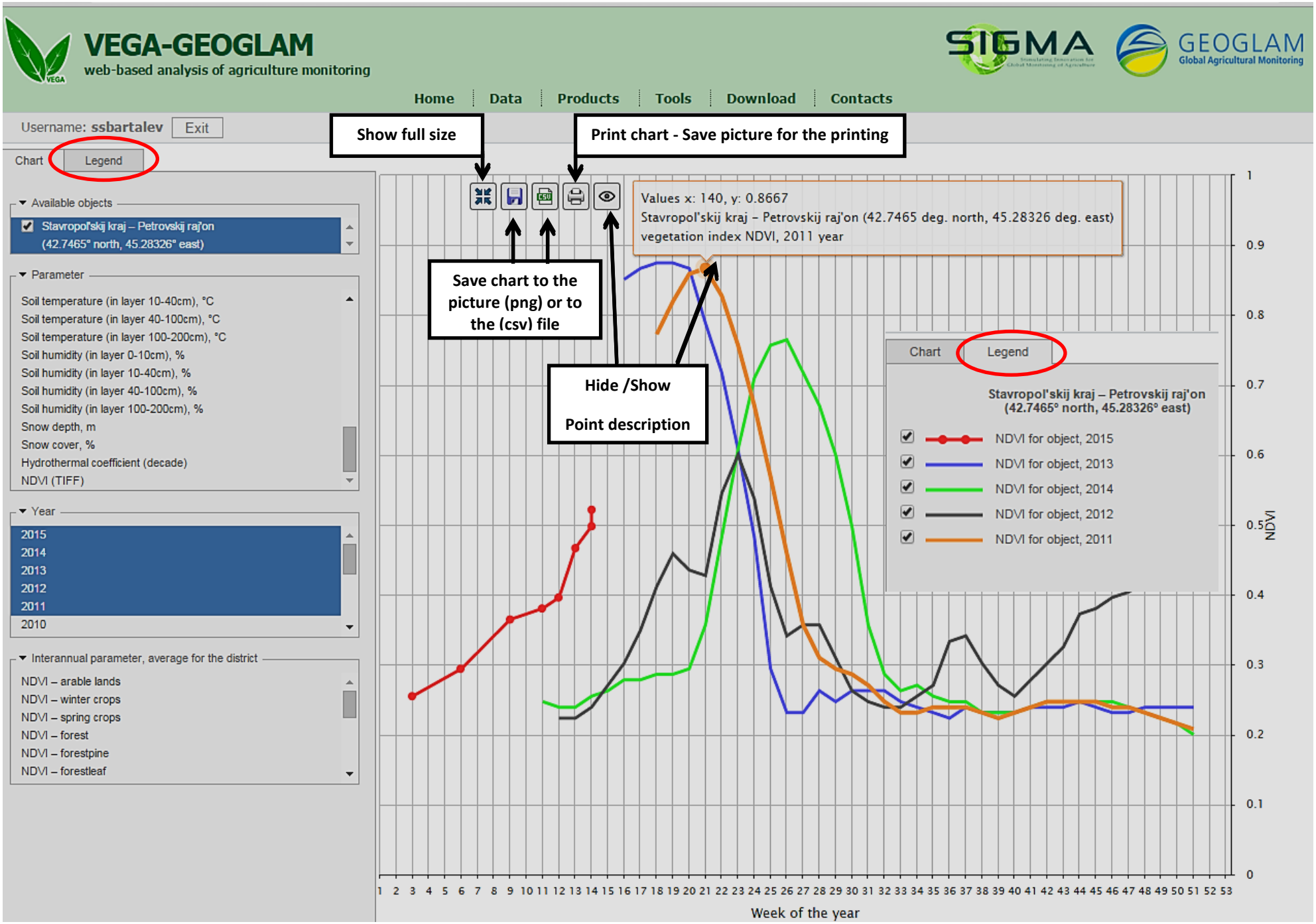
Note: using **High resolution data** we recommend switching off **Moderate resolution data** and **Temporal composite images** tabs



15. NDVI dynamics in the user defined objects

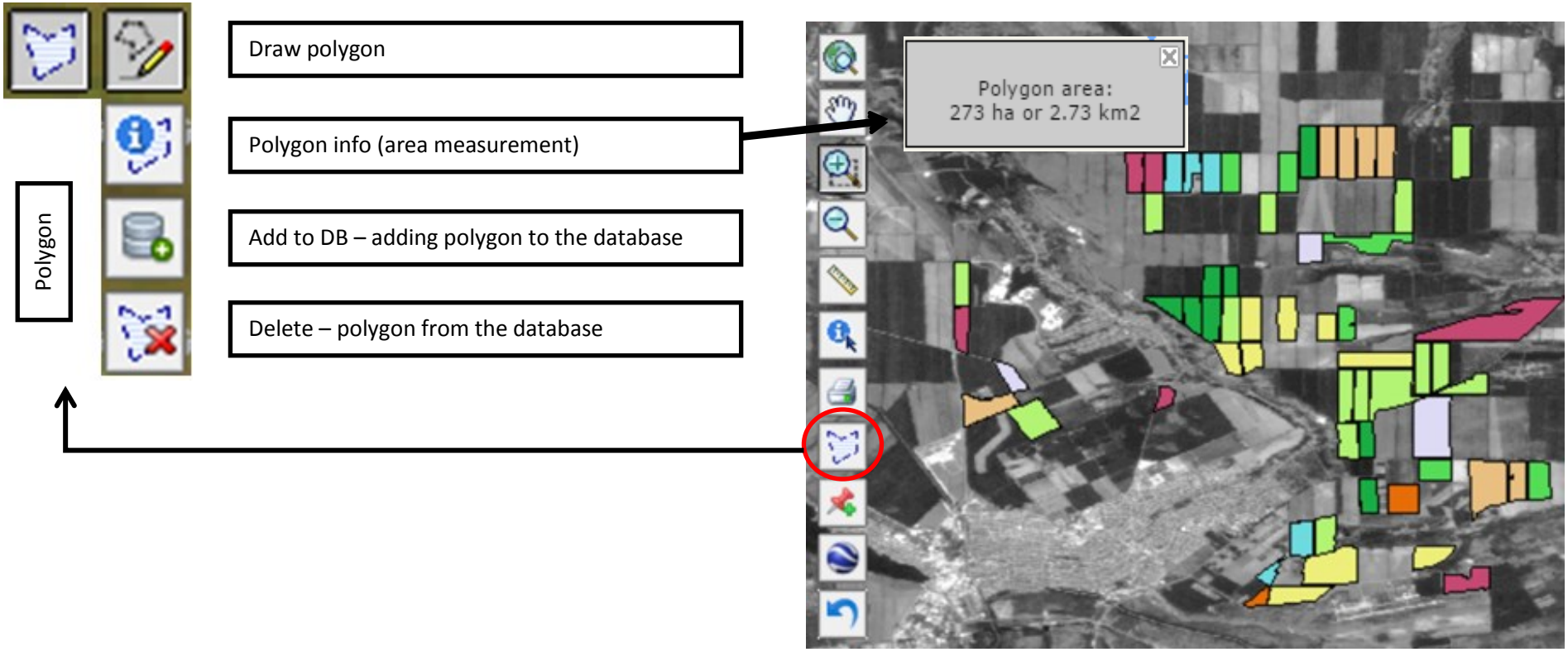
Infoclick button allows visualising NDVI dynamics in the user defined objects using MODIS time-series data. At the charts below you can find an example of NDVI profile for the five different years. User could visualise also NDVI mean temporal profile for the region and different types of vegetation. There is also information about soil and air temperature, air and soil humidity, pressure, snow depth and some others.



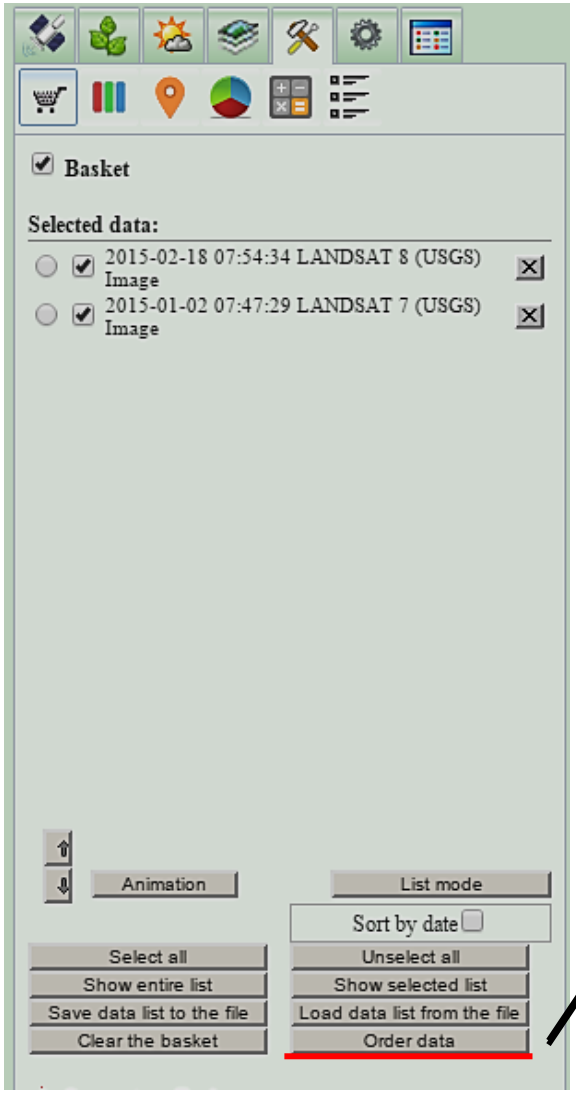

VEGA-GEOGLAM
web-based analysis of agriculture monitoring
SIGMA
GEOGLAM
Global Agricultural Monitoring
Home
Data
Products
Tools
Download
Contacts
Username: ssbartalev
Exit
Chart
Legend
Available objects
Stavropol'skij kraj – Petrovskij raj'on
(42.7465° north, 45.28326° east)
Parameter
Soil temperature (in layer 10-40cm), °C
Soil temperature (in layer 40-100cm), °C
Soil temperature (in layer 100-200cm), °C
Soil humidity (in layer 0-10cm), %
Soil humidity (in layer 10-40cm), %
Soil humidity (in layer 40-100cm), %
Soil humidity (in layer 100-200cm), %
Snow depth, m
Snow cover, %
Hydrothermal coefficient (decade)
NDVI (TIFF)
Year
2015
2014
2013
2012
2011
2010
Interannual parameter, average for the district
NDVI – arable lands
NDVI – winter crops
NDVI – spring crops
NDVI – forest
NDVI – forestpine
NDVI – forestleaf
Show full size
Print chart - Save picture for the printing
Save chart to the picture (png) or to the (csv) file
Hide /Show
Point description
Values x: 140, y: 0.8667
Stavropol'skij kraj – Petrovskij raj'on (42.7465 deg. north, 45.28326 deg. east)
vegetation index NDVI, 2011 year
Chart
Legend
Stavropol'skij kraj – Petrovskij raj'on
(42.7465° north, 45.28326° east)
NDVI for object, 2015
NDVI for object, 2013
NDVI for object, 2014
NDVI for object, 2012
NDVI for object, 2011
NDVI
Week of the year

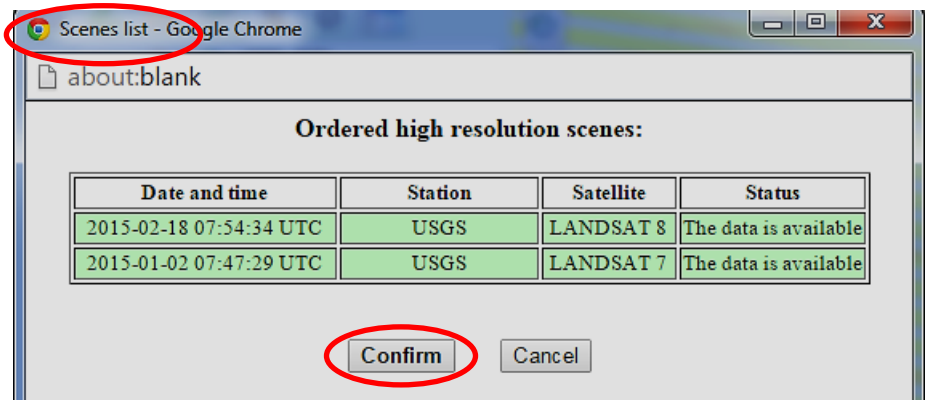
16. Polygons drawing that tool allows drawing polygons (objects) in the map interface. There are two options in this tool: 1) it is allows area measurement, 2) user can use polygons as AOI (Area of interest). Below you can find examples of polygons drawing on agriculture fields.

Notice: to finish polygon drawing you should locked first and the last vertexes with one click. Otherwise system will generate erroneous polygon.



17. Data ordering and downloading User could order images that have been loaded to the **Basket**. To make it necessary to open **Basket** in the tab **Data analysis** and push the button Order data. Than Scenes list will appear and user have to confirm the order. In about 10 minutes user is expecting to receive an e-mail with an ftp links for data downloading. The data stored in a zip files, which includes metadata and GeoTIFF image files. Links are available for users during next ten days.





18. Bug report

In case of any technical issues, please inform the system administrator using the bug report form. Comments and suggestions are also welcome.