Satellite Data Review and Analysis Application

User manual V.1

CONTENTS

OVERVIEW

The Satellite data review and analysis application (here and after – application) provides users with possibility to monitor, analyse data and relying on the results make decisions. Using the application users can make statistical analysis of land cover data for the territory of Lithuania based on actual NDVI mosaics created from automatically updated and geoprocessed Sentinel satellite raster images. Creation of actual NDVI, NIR, RGB mosaic data and provision them for the users in Lithuanian spatial data portal (here and after – SDI) is completely automated process. The mosaics are processed from actual Sentinel-2 satellite raster images for the territory of Lithuania that are automatically downloaded from the primary data provider – European Space Agency – and processed in the side of national SDI portal.

The application is developed under the project "Increasing Copernicus data usability by integrating it with Lithuania spatial data infrastructure services and apps (InCULT)" which references to the Announcement of Opportunity AO/1-8582/16/NL/NDe 2nd Call for Outline Proposals under the Plan for European Cooperating States (PECS) in Lithuania.

The State Enterprise National Centre for Remote Sensing and Geoinformatics "GIS-Centras" (here and after – SE "GIS-Centras"), located in Vilnius (Lithuania) is the author of the concept of the application, the developer and manager of released application.

The application is provided in Lithuanian SDI portal. The URL address of the application: https://www.geoportal.lt/incult/.

Lithuanian SDI portal is the main access point of official and actual geographical information, thematic spatial data sets provided from primary data sources for the territory of Lithuania. State registers and cadasters, municipal and governmental information systems, public and private sector, scientific and educational organisations are the main data providers. The portal was launched in 2009 and users can find it at www.geoportal.lt

Ministry of Agriculture is the owner of Lithuanian SDI portal, and SE "GIS-Centras" is the manager of the portal.

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1. SENTINEL INFORMATION MANAGEMENT APPLICATION

Information about how to use the application in order the user could gain all the best from the application is provided in the chapter below.

Data specification of Sentinel Satellites data (exactly of Sentinel-2 products from Level-0 up to Level-2A https://sentinel.esa.int/documents/247904/349490/S2_MSI_Product_Specification.pdf) is provided in the Document library in Sentinel Online technical website of the European Space Agency here: https://sentinel.esa.int/web/sentinel/document-library/content/-/article/sentinel-2-level-1-to-level-1c-product-specifications

Attribute table information of NDVI, RGB and NIR data mosaics based on processed Sentinel raster images is provided in the data specification document (https://www.geoportal.lt/geoportal/en/web/en/documents).

1.1. An Overview Window of the Application

Satellite data review and analysis application owns the basic functionality of the map browser of SDI and has additional functionality.

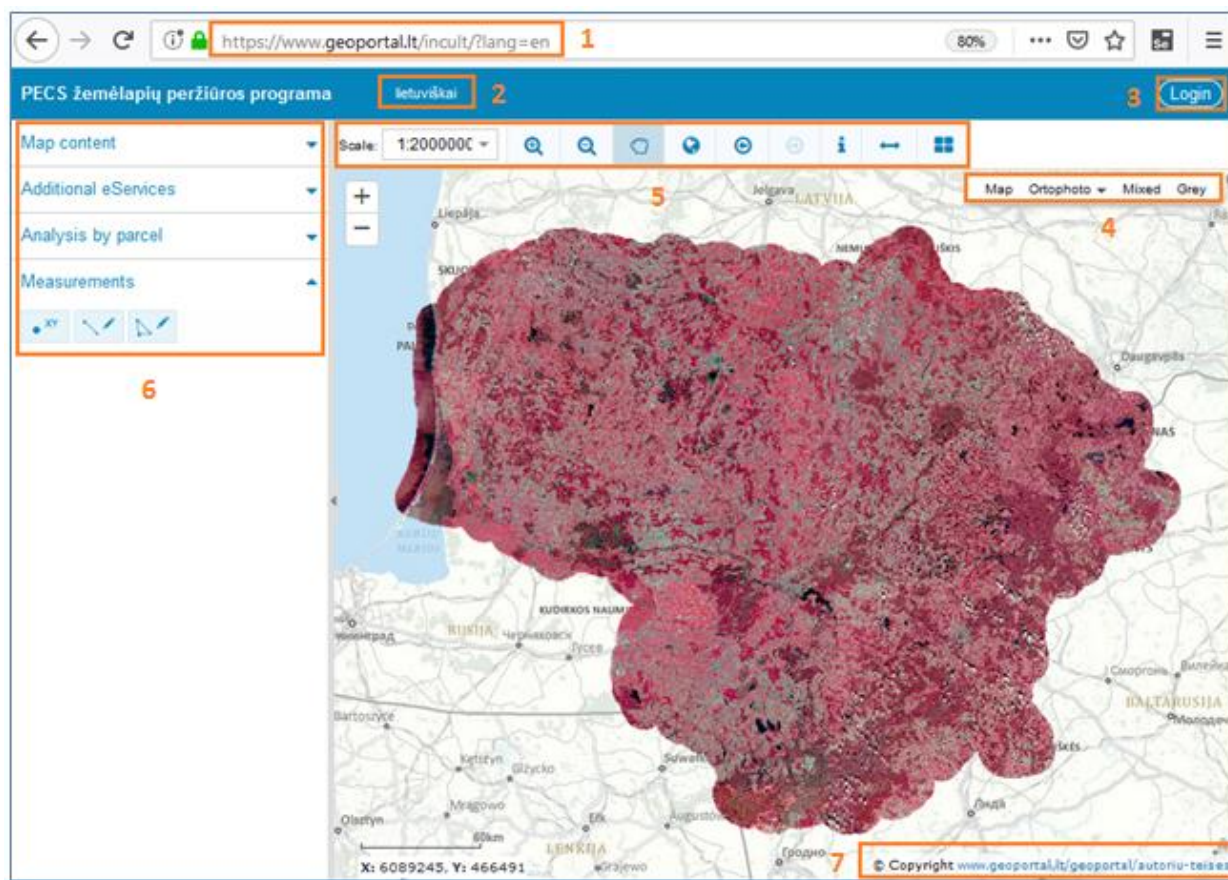The overview window of the application is provided below (Figure 1).

Figure 1. An overview window of Satellite data review and analysis application

(1. URL address of the application; 2. Link to switch between Lithuanian and English languages in the application; 3. A link to login into an application; 4. A zone of background map selection; 5. A ribbon of buttons of map functionality; 6. A menu bar of additional functionality of the application; 7. Copyrigt information of map content)

1.2. Map Content

There are several map layers used in Satellite data review and analysis application:

- A background map;
- Additional eServices.

A background map. The main vector map of SDI as a background map is shown in Satellite data review and analysis application by default. The user can find the background map under the "Map Content" tab or in the top right corner of the map window.

In order to change the background map type, the user needs to check the required map in the top right corner of the map window.

There is possibility to choose one of the background map types:

- Map;
- Orthoto;
- Mixed;
- Grey.

Additional eServices. Additional eServices are located under the tab "Additional services". The user can choose from these available layers and make them visible in the map window:

- Actual thematic Sentinel data layers;
- Thematic geoportal.lt layers.

Actual thematic Sentinel data layers are viewable at small scales from 1: 3 000 000 to 1:25 000. Actual thematic Sentinel data layers consist of:

- NDVI (Normalised Difference Vegetation Index) mosaic data.

NDVI value represents vegetable conditions in particular area and can be compared and analyzed at different time periods if user makes such analysis constantly.

NDVI is calculated from the visible and near-infrared light reflected by vegetation.

NDVI is calculated from these individual measurements as follows:

NDVI = (NIR – Red)/ (NIR+Red), where RED and NIR stand for the spectral reflectance measurements acquired in the red and near-infrared regions, respectively.

- NIR (Near Infra-Red) mosaic data.

Band combination:

   o Near infrared
   o Green
   o Blue

- RGB (Red Green Blue) mosaic data.

Band combination:

   o Red;
   o Green;
   o Blue.

Thematic geoportal.lt layers that are orthophotographic maps for the territory of Lithuania of different years are provided. The administrator of Satellite data review and analysis application

creates the list of layers and the layers offered in the list can be changed according to administrator's decision.

There is possibility to turn on/off the background map layer in the "Map Content" tab in order to make the map visible/not visible in the map window, and possibility to remove map layer – only for additional map layers in order to make the map layers to be selectable further in the analysis process.

Once the layers are added to the map content, buttons for layer settings manipulation appear. Depending on activated buttons, turn on/off the layer, remove layer, legend, settings (for showing overall service coverage, manipulation of opacity), search (for choosing the layer to search within an object), information (service URL, type, description) functionality is offered (Figure 2).
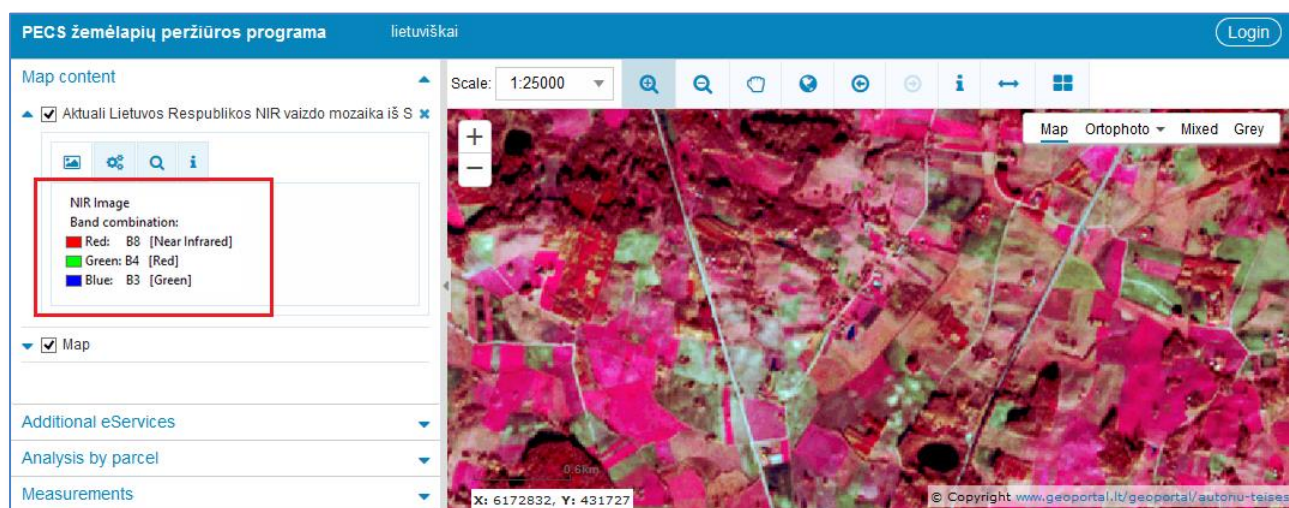
Figure 2. Provision of the legend and other functionality of data layer in the map content

1.3. Basic Functionality

A map viewer is the main component of the national SDI portal. National SDI map viewer has a modular structure and newly created components of Satellite data review and analysis application were developed as additional modules to this modular structure. The whole core of Satellite data review and analysis application is related to standard map viewer functionality (like zooming, panning, showing legends, measurements, etc.).
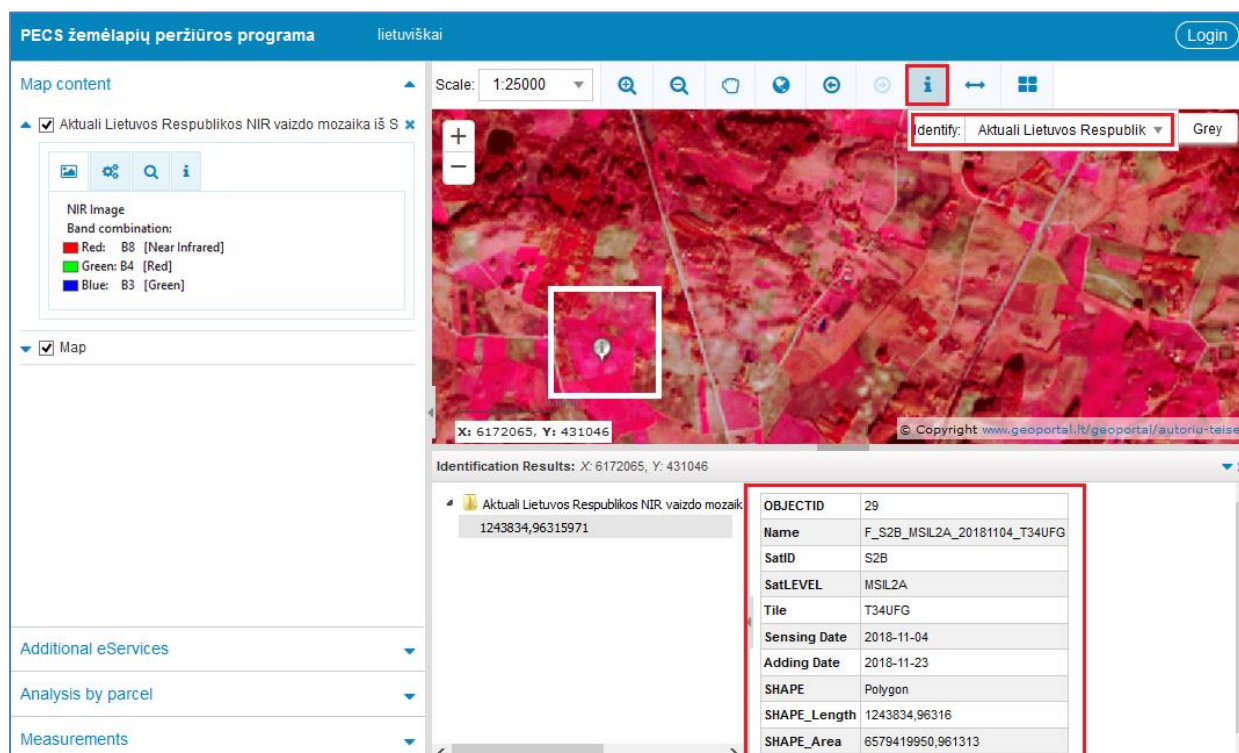
The main functionality of the map browser and Satellite data review and analysis application is provided in the Table 1.

Table 1. The main functionality of the map browser in Satellite data review and analysis application

Icon title	An icon

Zoom in	
Zoom out	
Pan	
Show full map	
Previous extent	
Next extent	
identify	

NIR mosaic raster cell identification information as an example of identification tool usage is provided in the figure below (Figure 3).

Figure 3. NIR mosaic identification information is provided using object identification tool

1.3.1. Measurements

The user can use "Measurements" tab in order to get object coordinate information, length and area parameters (Figure 4).
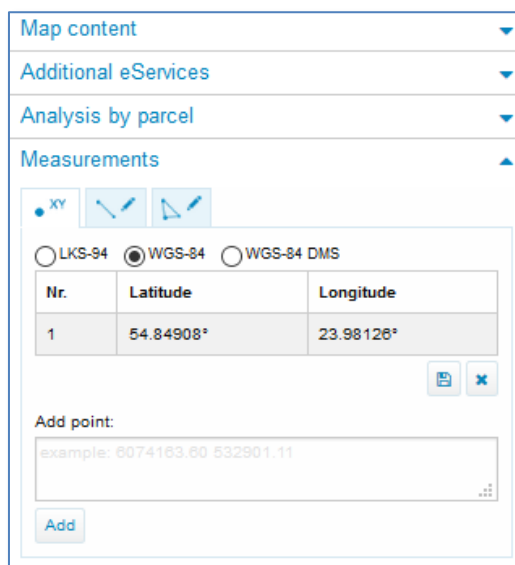

Figure 4. Object coordinate information, length and area can be obtained using measurement functionality

The advantages of the "Measurements" functionality:

- Can be entered as many objects as needed;
- If there is no more need of several objects in the measurements list, then the user can delete undesired objects from the list and leave only required object information;
- After a distance and area are drawn, they can be modified by using edit points; the measurement results are updated synchronically;
- Possibility to download measurement results as SHAPE, CSV files.
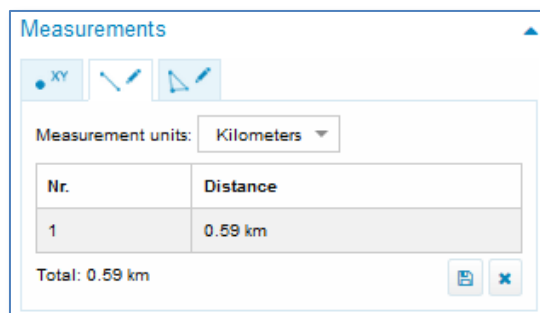
In addition using "Get point coordinates" the user can change between the coordinate systems: LKS-94, WGS-84, WGS-84 DMS. The point can be added to the map in visual manner or values can be entered manually (Figure 5).

Figure 5. The window to enter coordinate information and to choose coordinate system
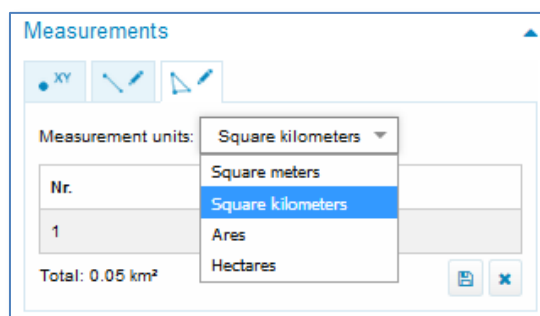
Using "Get distance" tab, there is possibility to measure object distance in meters or kilometers (Figure 6).

Figure 6. The window to change measurement units of the distance

Using "Measure area" tab, there is possibility to measure object area in square meters and kilometers, acres and hectares (Figure 7).

Figure 7. The window to change measurement units of the polygon

1.4. Additional functionality

Satellite data review and analysis application provides possibility to:

- Compare processed Sentinel imagery. That means, viewing, searching and comparing processed Sentinel imagery together with thematic layers of NSDI portal. There is possibility to compare between different numbers of thematic layers. The user can compare layers using method of revealing layers or using synchronized zooming to the analogue place in different maps;

- Analyze processed Sentinel imagery. Geoprocessing service is used for provision of spatial analysis of processed Sentinel imagery and visual analytics.

1.4.1. Comparison of thematic layers

There is a button for comparison between two different thematic layers by revealing underneath layer ⟷ in the ribbon of the buttons above the map (Figure 8).
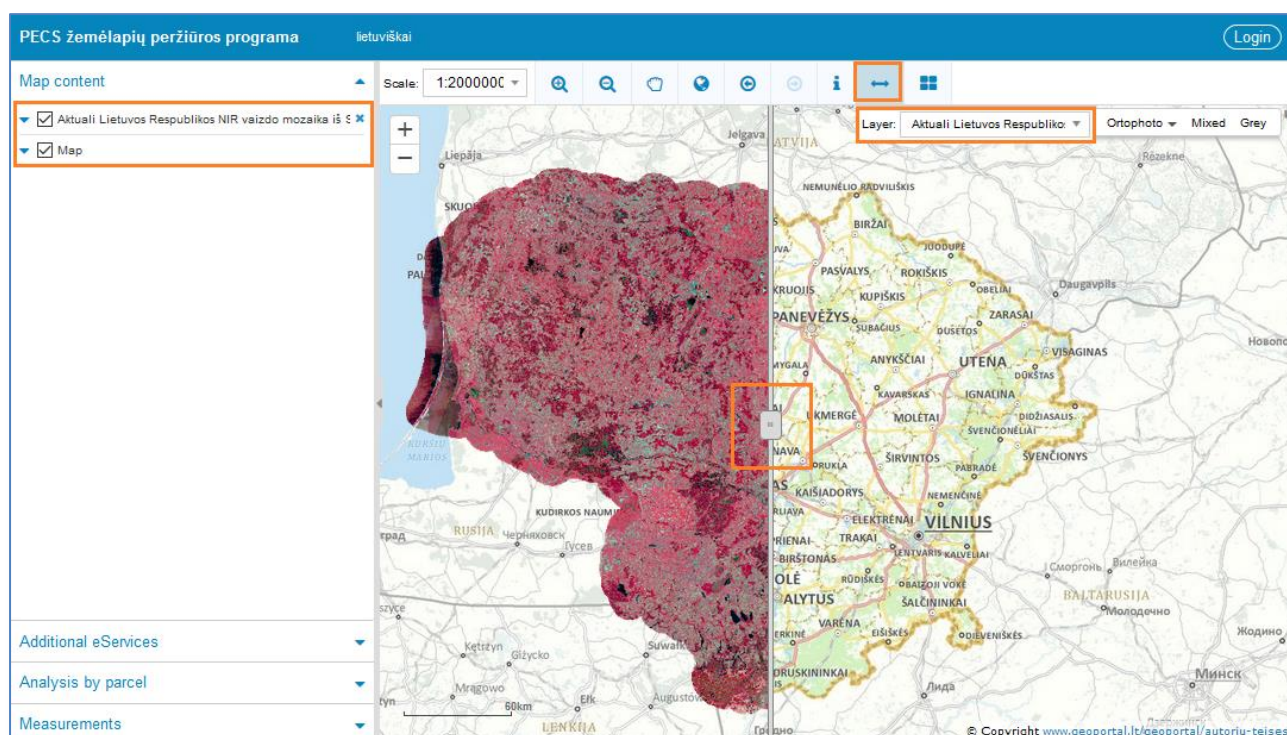

Figure 8. The comparison of layers using revealing method

The layers used in comparison are those that come directly from the Map Content (exactly the layers that are checked in the list). The layers the user chooses for comparison, are displayed in the map window and the user can perform layers comparison by revealing maps. The user reveals maps by

dragging the button in the center of the screen in horizontal direction (Figure 8. The comparison of layers using revealing method).

There is another method for layers comparison. The user need to press the button in order to compare two or four layers (Figure 9).

Figure 9. The button for comparison of the layers by synchronized zooming in the map

When the user zooms in or out to one of the maps, addition zooming is performed in every map. The button in the right up corner of every map is used for getting the list of possible layer to compare (Figure 10).
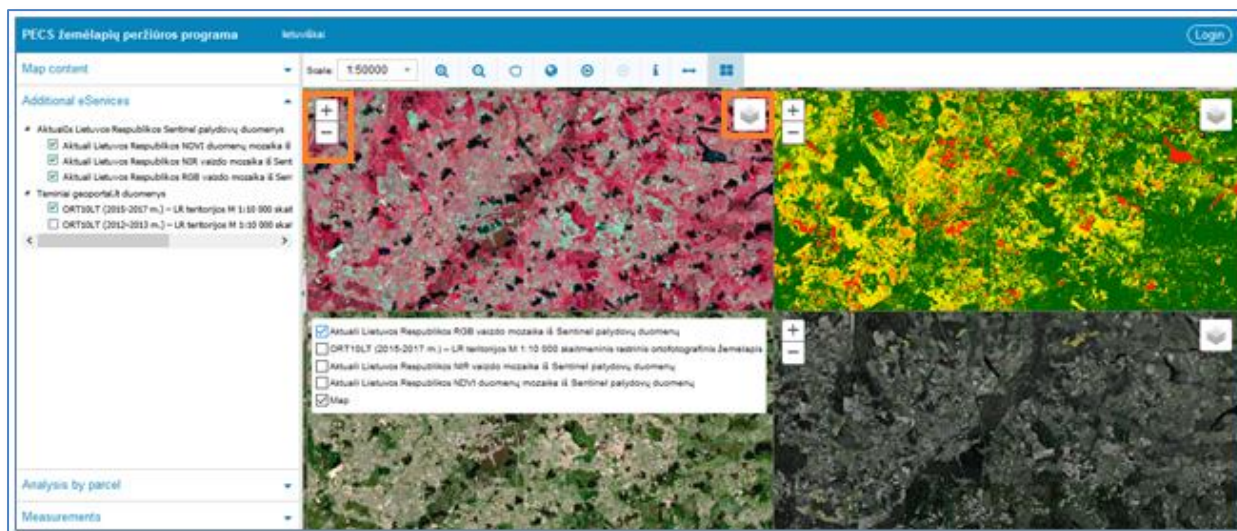

Figure 10. The comparison of the layers by synchronized zooming in the map

The values of the map list come directly from the map content. If the layer is checked in the map content, then it appears in comparable layers list (Figure 11). Also the background map is provided in the list by default.
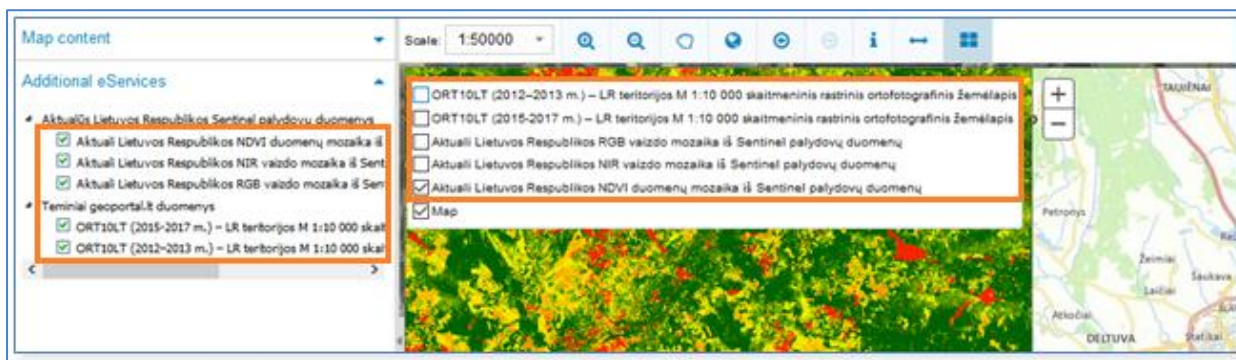
Figure 11. Checked layers of the Map Content are provided for comparison

If all layers are checked in the map content, then all layers are possible to use in comparison functionality.

1.4.2. Analysis by parcels

The Analysis functionality is provided in the menu tab in the left side of the map window in the application. When the user opens menu tab "Analysis by Parcels", then he needs to choose the way to get the polygon information.

There are these two methods to get the polygon object for the analysis (Figure 12):

- Draw polygon;
- Choose analysis objects from the user's own resources that are stored in Spatial Data Management System (here and after – EDVI) in geoportal.lt.
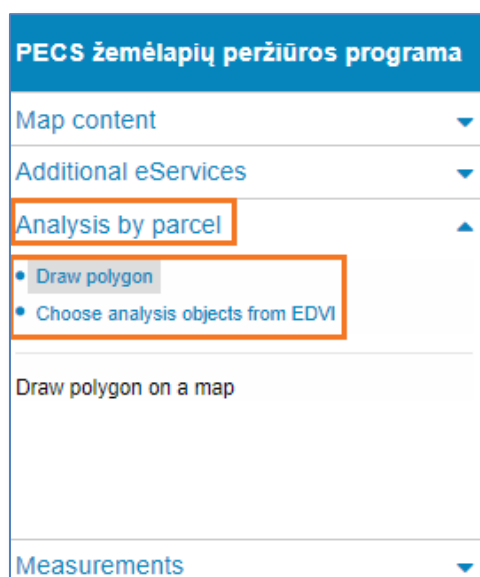

Figure 12. Possibility to choose different methods of Analysis by parcels

After the method *by drawing polygon* is chosen, the user needs to draw polygon directly in the map (Figure 13). There is limitations – polygon area cannot exceed more than 400 km^2 of the territory in the map.

Figure 13. Drawing of the polygon for the statistical analysis of processed actual Sentinel imagery data

*Choosing an object from EDVI i*s another method for choosing a polygon for statistical analysis.

The user must be logged in geoportal.lt in order could see EDVI resources list (Figure 14).
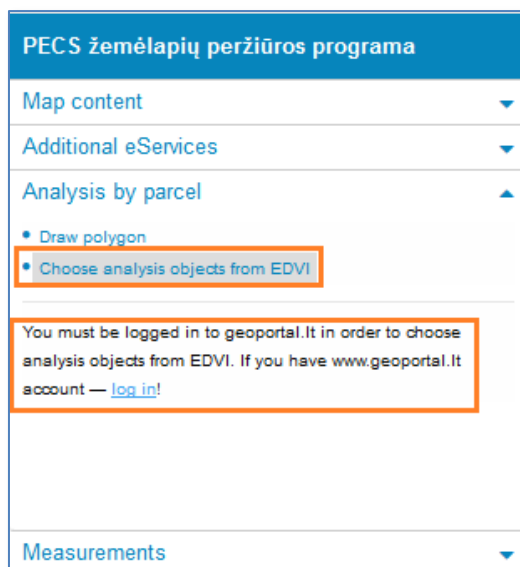

Figure 14. The user needs to be logged in geoportal.lt in order to see possible EDVI resources for analysis

After logging in, the user can see the list of EDVI resources. Only polygon layers are shown in the list. Both private, and shared layers are listed and can be added to Satellite data review and analysis application for analysis purposes (Figure 15).
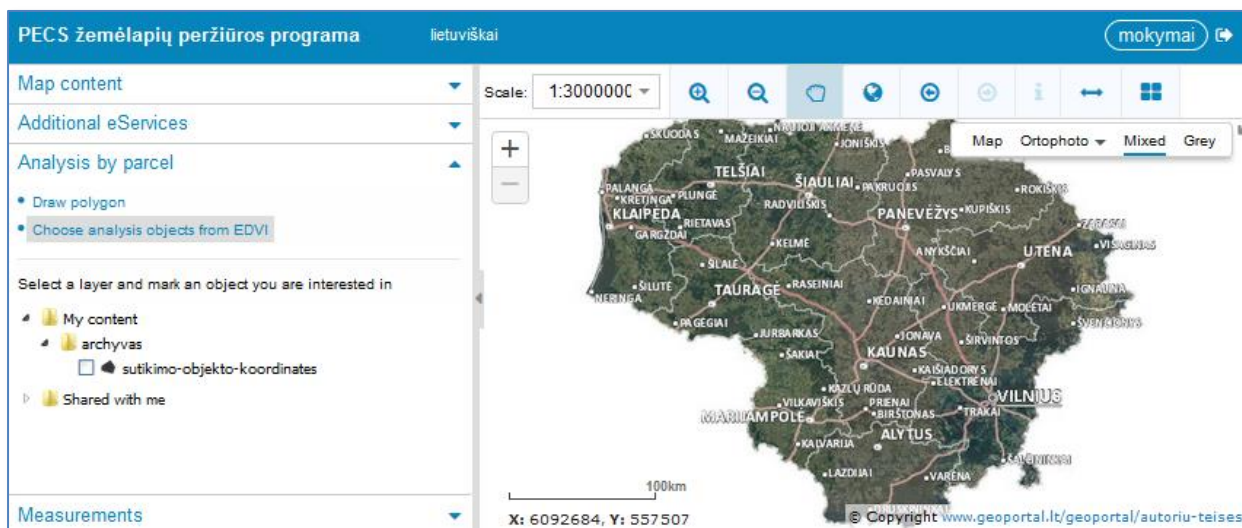

Figure 15. Both private, and shared polygon map layers are listed among EDVI resources and can be added to Satellite data review and analysis application for analysis purposes

The user needs to select EDVI resource and mark an object he is interested in statistical analysis to be provided.

Web service for converting vector analysis polygon defined by user and calculating NDVI statistics are one of the key features in Satellite data review and analysis application.

NDVI values can be calculated between -1.0 and 1.0 depending on land cover type. These are the types of land cover plots and corresponding ranges of NDVI values:

- NDVI values of soils and land cover plots without vegetation exhibit a near-infrared spectral reflectance larger than the red, and thus tend to generate rather small positive NDVI values and are between 0.0 and 0.1;
- NDVI values of water bodies (lakes, rivers) which have a rather low reflectance in both spectral bands result in very low positive or even slightly negative NDVI values. NDVI values are between -1.0 and 0.0;
- NDVI values of land cover plots under vegetation are between 0.2 and 1.0.
  - Healthy vegetation absorbs most of the visible light that hits it, and reflects a large portion of the near-infrared light. NDVI values are near 1.0;
  - Unhealthy or sparse vegetation reflects more visible light and less near-infrared light. NDVI values are near 0.2.

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Geoprocessing tool for calculating raster statistics allows taking the analysis area defined by user in Satellite data review and analysis application as a vector data set and performing statistical calculation in NDVI raster data set.

The statistic type which can be calculated in NDVI raster data set using geoprocessing tool:

- Mean – calculates the average of all cells in the NDVI raster;
- Minimum – determines the smallest value of all cells in the NDVI raster;
- Maximum – determines the largest value of all cells in the NDVI raster;
- STD – standard deviation;
- Area – user defined area for calculating statistics in hectares.

As the statistical analysis of the polygon is performed, the results of analysis are provided below the map (Figure 16).

Figure 16. When the statistical analysis of the polygon is performed, the results of analysis are provided below the map

There is a download link of analysis results as JSON (Figure 17) and CSV files (Figure 18).
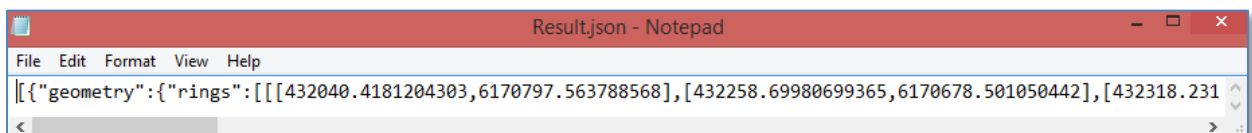

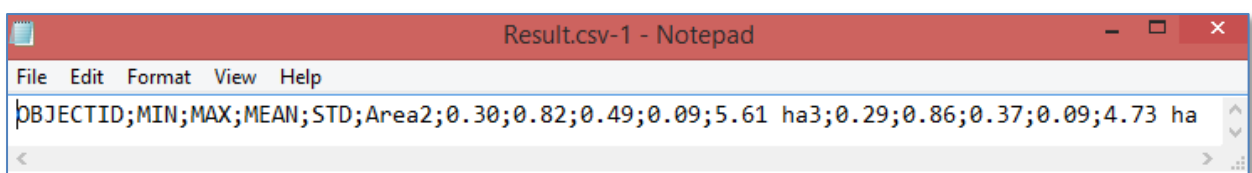**Figure 17.** Statistical analysis results of processed NDVI Sentinel imagery data as JSON file

Figure 18. Statistical analysis results of processed NDVI Sentinel imagery data as CSV file

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By closing the result window the user can remove the analysis results and the polygons used for analysis in the map.

The user can make analysis of as many parcels as needed. By pressing button "Close", statistical analysis results and the polygon analyzed are removed. A new statistical analysis session can be performed.

1.5. Functionality for registered and not registered users

Different functionality is offered for registered and logged in users and for non-registered geoportal.lt users. Registered and logged in geoportal.lt users can get their EDVI resources and use them in the statistical analysis. There is no other differences in functionality or map content, except mentioned EDVI resources access limitations, for any type of users.

1.6. Localization of the application

There are two language versions of Satellite data review and analysis application.

https://www.geoportal.lt/incult/ is the URL address of Satellite data review and analysis application version in Lithuanian, and https://www.geoportal.lt/incult/?lang=en – the URL address of Satellite data review and analysis application version in English.

1.7. Help information

The questions about how to use Satellite data review and analysis application can be provided to the administrator of the application using geoportal.lt request form https://www.geoportal.lt/geoportal/en/web/en/contacts-/-help-requests or via e-mail info@geoportal.lt

Satellite data review and analysis application – for effective land cover data management!