SEVENTH FRAMEWORK PROGRAMME

CAPACITIES - ERA.Net RUS: Linking Russia to the ERA

Contract for: **Innovation Project**

D.7

GEOURBAN Information System

Project acronym: **GEOURBAN**
Project full title: Exp**l**oitin**G**
                                   Earth **O**bservation in
                                   s**U**stainable u**RB**an
                                   pl**A**nning & ma**N**agement
Contract no.:   ERA.Net-RUS-033
Date: 25/11/2013

Doc.Ref.: GEOURBAN_39_TR_GRADI
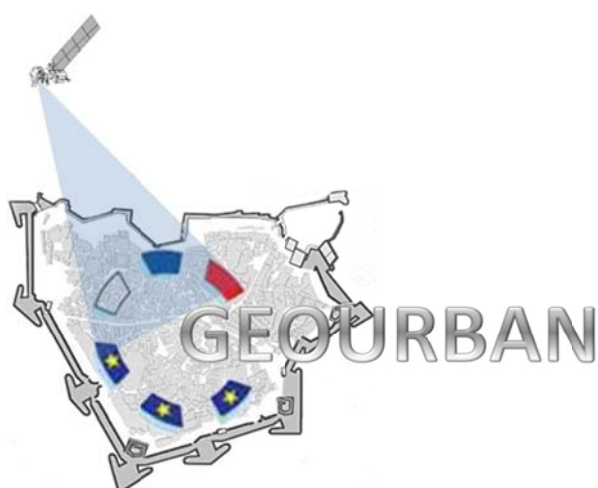
Book Captain: Anna Sazonova
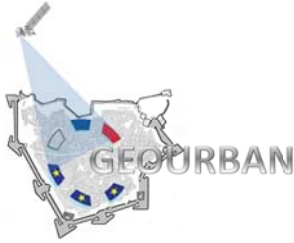
Contributors: Nektarios Chrysoulakis

Issue: 1.0

Deliverable no.:   D.7

Dissemination: PU

`

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 2/23

GEOURBAN

Document Status Sheet

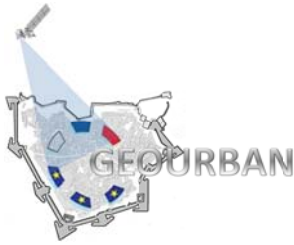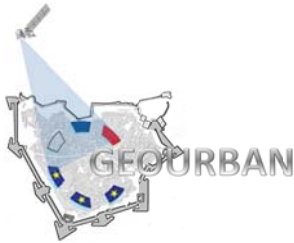| Issue	Date	Author	Comments
0.0	20/05/2013	A. Sazonova	Draft out for consortium review
0.1	10/09/2013	A. Sazonova	Draft out for new structure confirmation
1.0	25/11/2013	A. Dudarev, N. Chtysoulakis	Review

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 3/23

Table of Contents

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 4/23

GEOURBAN

1. WORKPACKAGE OVERVIEW

It is a visual resulting WP in GEOURBAN project, because the main design and developing activities focus on the implementation of all WP's results through the Web-based Information System (WIS) GEOURBAN. The output of this WP is the prototype of GEOURBAN information system that should be easy transferable from city to city and a report about the development of the WIS. It is the tool to provide end-users such as urban planners, architects and engineers with spatial data by using web services, mapping and analyzing the urban surface structure, planning and management in the urban environment through using of the information system. **WP7** contiguously interacts with **WPs 2, 3, 4, 5** and **6** and give inputs to **WPs 8** and **9**. GRADI leads **WP7**; FORTH, KUZGUN, DLR, UNIBAS and GARD participate.

1.1. Purpose of the document

This document is the deliverable D.7 **Web Information System Development** of the GEOURBAN Project. It provides the required information about web information system. It includes the description of the WIS's appearance and functionality. More specifically, data requirements and detailed guidelines for the user are also included.
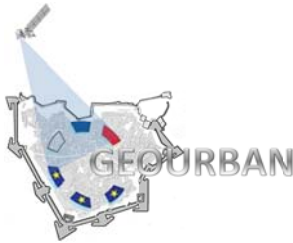
1.2. Document references

Beregovskih A., Research. Conception: Information and Analytical System of Urban planninG and management of territoRy development (IAS UGRT), Volume 178, Issue 2011, ISBN 978-58042-0187-7.

1.3. Definitions and acronyms

Acronyms

Web Information System (WIS)

2. Web Information System description

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 5/23

GEOURBAN

The GEOURBAN WIS is developed by GRAD Inform Ltd. using in-house developed software and algorithms for spatial analysis and web visualization.

The WIS prototype can be accessed via http://geourban-fp7-eranet.com. It is a fully dynamic system exploiting all internet capabilities and the "open layers" availability. The user solely needs a web-browser and internet connection to access the GEOURBAN WIS. Three GEOURBAN case studies have been included in the WIS prototype.
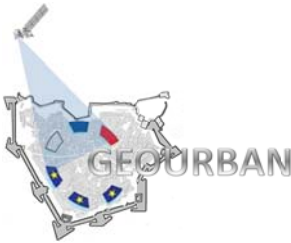
2.1.   Appearance of the WIS

The appearance of the WIS consists of:

1) Control Bar with **Layers** managing menu and set of layers with display tool, **Search** function which is has to be set with searching parameters, **Contacts** information menu, **Indicators, Guidelines and Questionnaire** menu with Indicators description, illustrated guidelines for the user and questionnaire for getting feedback from users, and **Log In** menu for authorization (the right boarder of the Bar is moveable);

2) **Tools Bar** with buttons '**Navigation**, '**Distance'**, '**Square'**, '**Create point object'**, '**Create line object'**, '**Create polygon object'**, '**Save map to png'**, '**Save layer to file'**, '**Map'** panel for choosing case study and '**Basic layer'** panel for choosing a background;

3) **Map display area** with standard set of tools available at **Navigation Bar** such as: '**Scale'**, '**Zoom In'**, '**Zoom Out'**;

4) **Status Bar**.

The prototype of the GEOURBAN WIS includes a standard set of tools which allow user to manage map switching layers on and switching them off, changing scale and displaying object's attributes such as value of indicator evaluation, measuring distance and evaluating square. The appearance of the WIS is illustrated on the figure 1.

All buttons and items of Tools Bar highlight and a message with the information about the function appears.

The prototype of the GEOURBAN WIS also includes **Configuration panel** which is available for administrator session. It allows to configure all visualization parameters for managing set of maps and layers especially for each user and searching options.
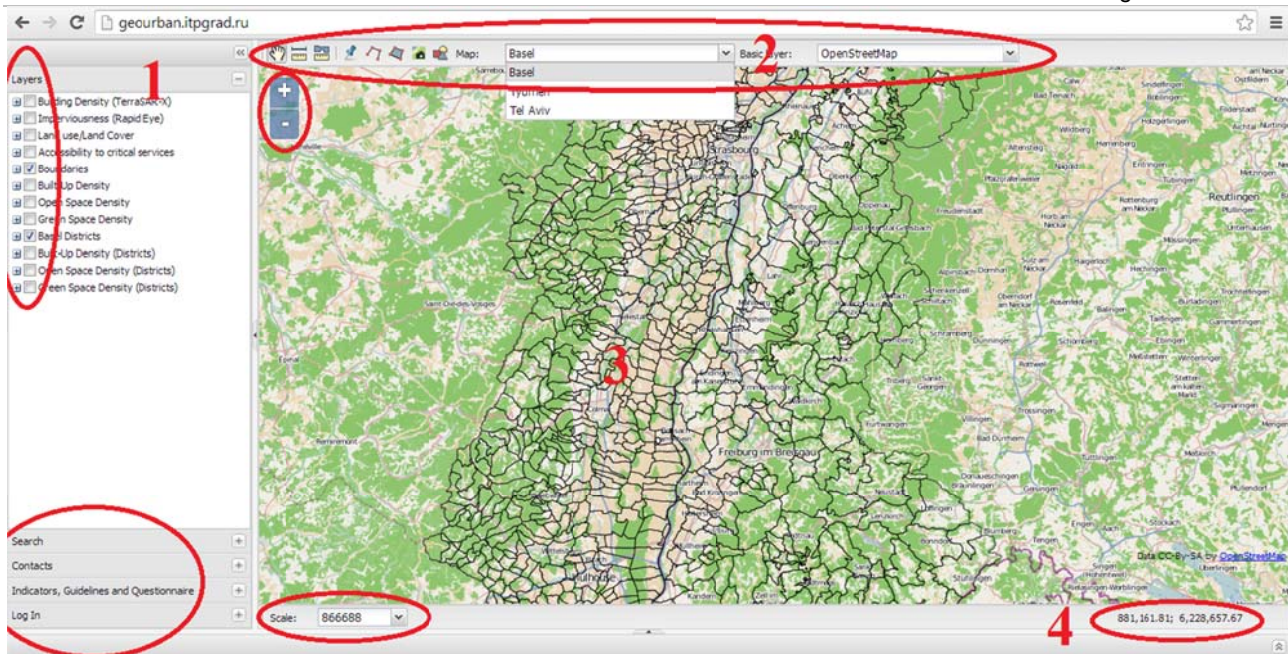
WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 6/23

GEOURBAN

Figure 1. The appearance of the WIS GEOURBAN

2.2.   Web Information System Functionality

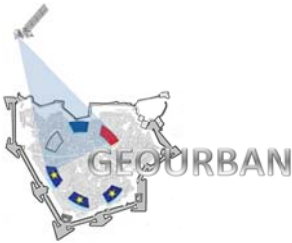**Functionality of the WIS for anonymous user (guest)**

Guest is a stakeholder who can see displayed map and have a rights for usual activities as:

1. Objects searching;
2. Get (See) object's attributes;
3. Manage map's (layer's) scale and area displaying;
4. Switch on/off layers;
5. Measure the distance;
6. Evaluate the square;
7. Create new point, line, polygon (without saving);
8. Save map to .png;
9. Save layer to file.

2.2.1. Object searching

Object searching functions defer by following searching criteria:

–   object type;

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 7/23

GEOURBAN

- name of object;

- others value of attribute.

Attribute's value searches through contents of the object's attribute table. That is why is available only for object which has attributes data. If several objects are found by click on the map there are search results form with list of objects it order needed object will be chosen to show it's attributes using 'Show attributes' button.

2.2.2. Display object attributes

User is able to see objects attributes by click at the needed object on the map. The object's card is shown on figure 2.
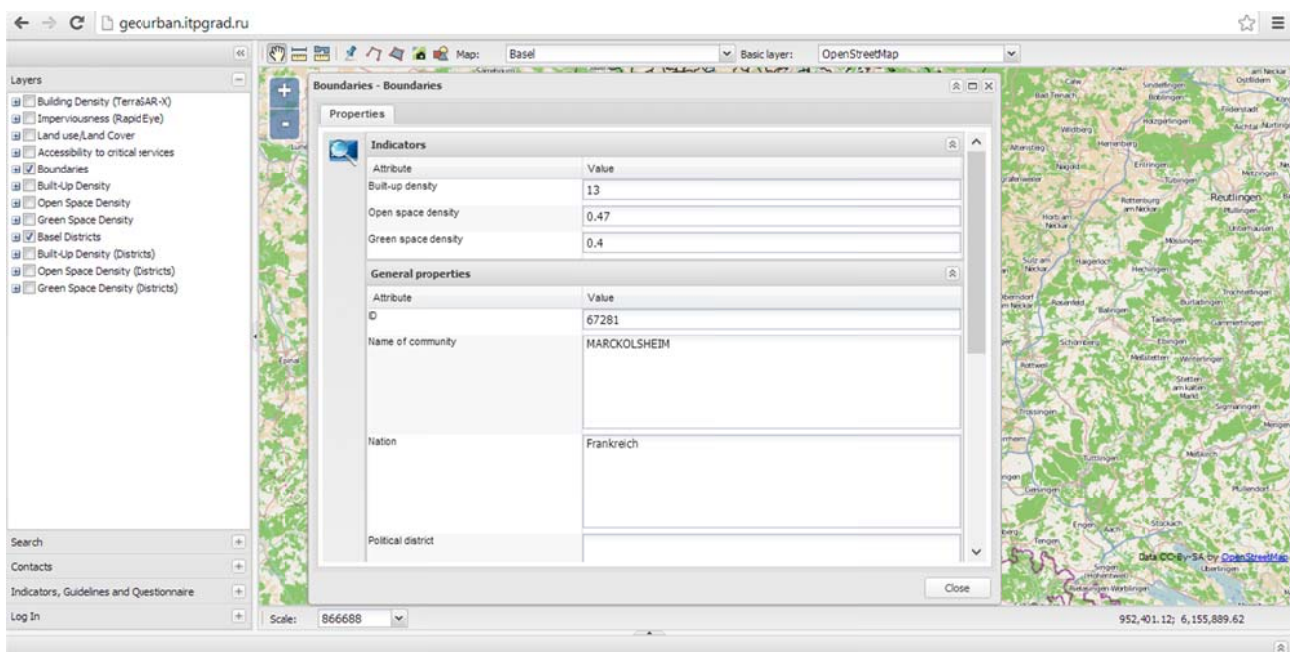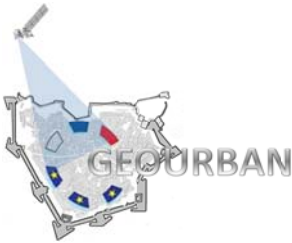

Figure 2. The object's card with attributes

2.2.3. Display the map (layers)

To display particular map it needs to be chosen from set of maps using 'Map' on the Tools Bar. In the Layers menu there are uploaded layers are displayed.

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
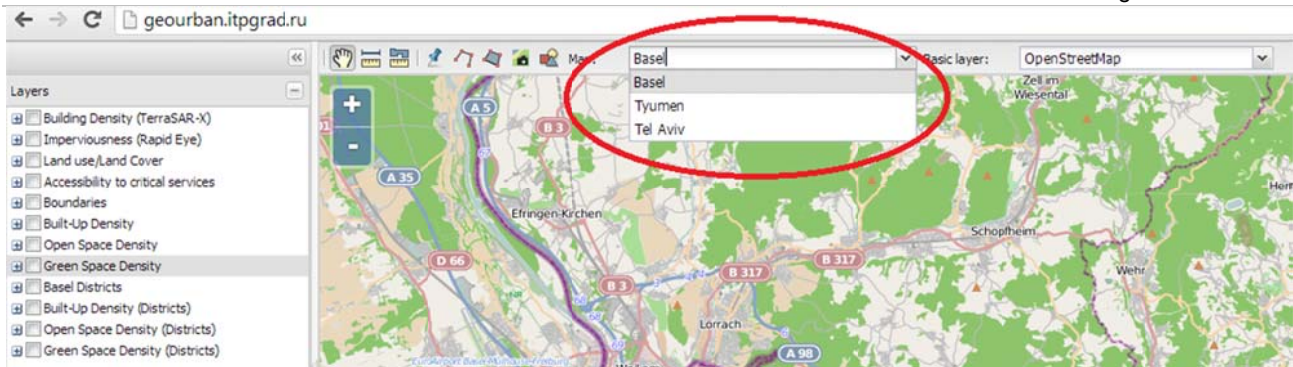Date: 25/11/2013
Page number: 8/23

GEOURBAN

Figure 3. Set of Maps (Case studies)

To change the displaying layers or display particular layer switch on the needed one and switch off the others.
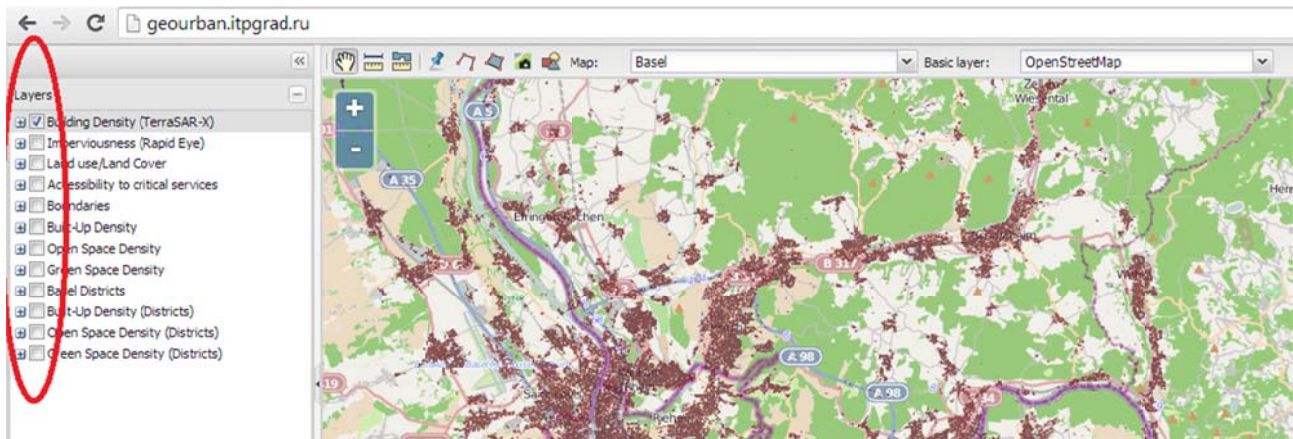

Figure 4. Set of Layers

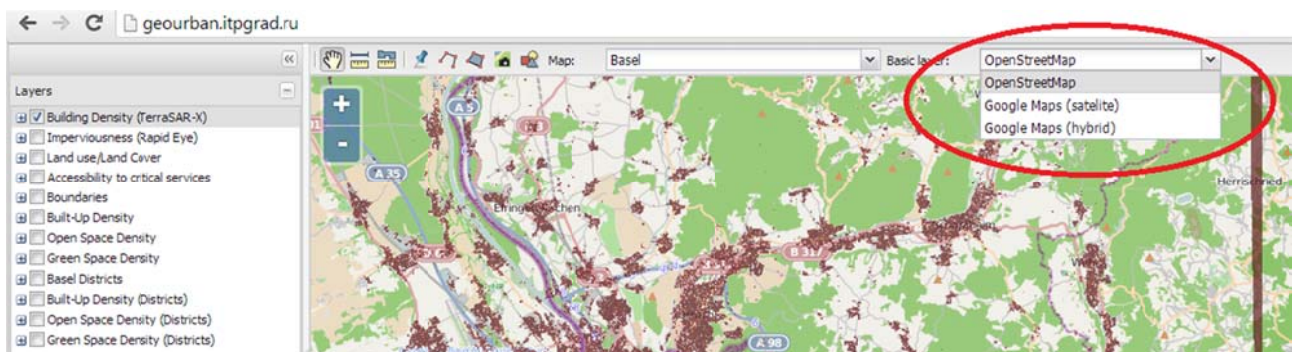**To change Basic layer** which is displaying use the 'Basic layer' on the Tools Bar.
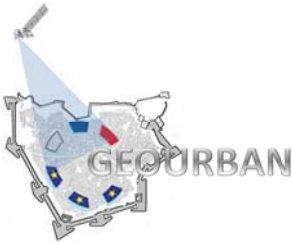

Figure 5. Set of basic layers

To change map scale there are several ways:

  – 'Scale' tool on the Map display area;

  – 'Zoom In', 'Zoom Out' tool on the Map display area;

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 9/23

GEOURBAN

- Set needed displaying boundaries holding down the left mouse button with 'shift' button on the keyboard;
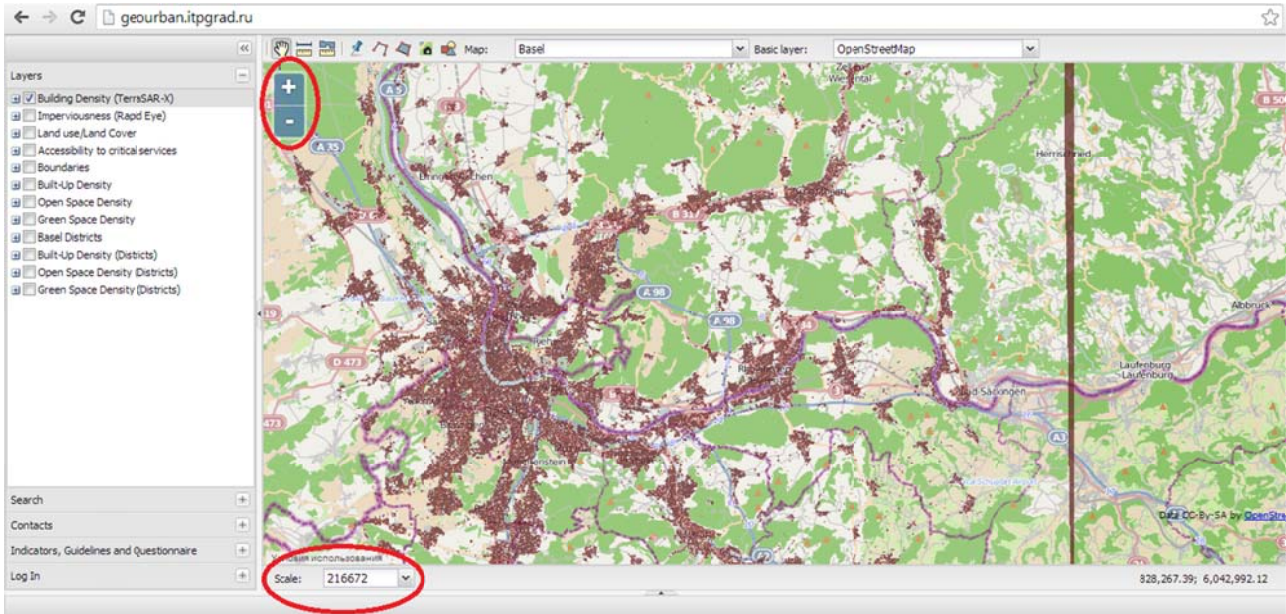
- and the scroll.

Figure 6. Scale tools

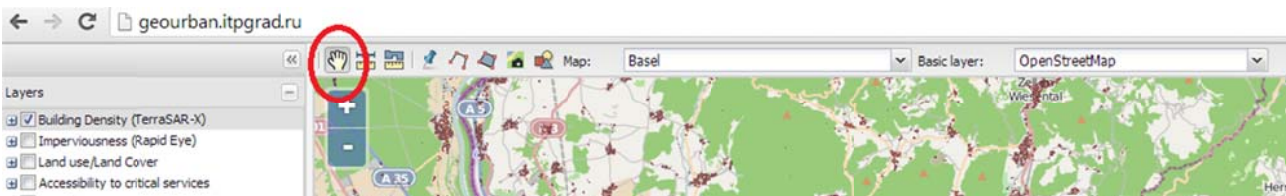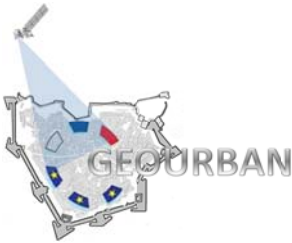**To move map** use tool 'Navigation' on the Tool Bar.

Figure 7. Navigation tool

To measure the distance there is special tool on the Tools Bar 'Distance'. It's able to measure the distance in one direction or length of polygon border. The result displays near the end point and at the Status Bar in different units.

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
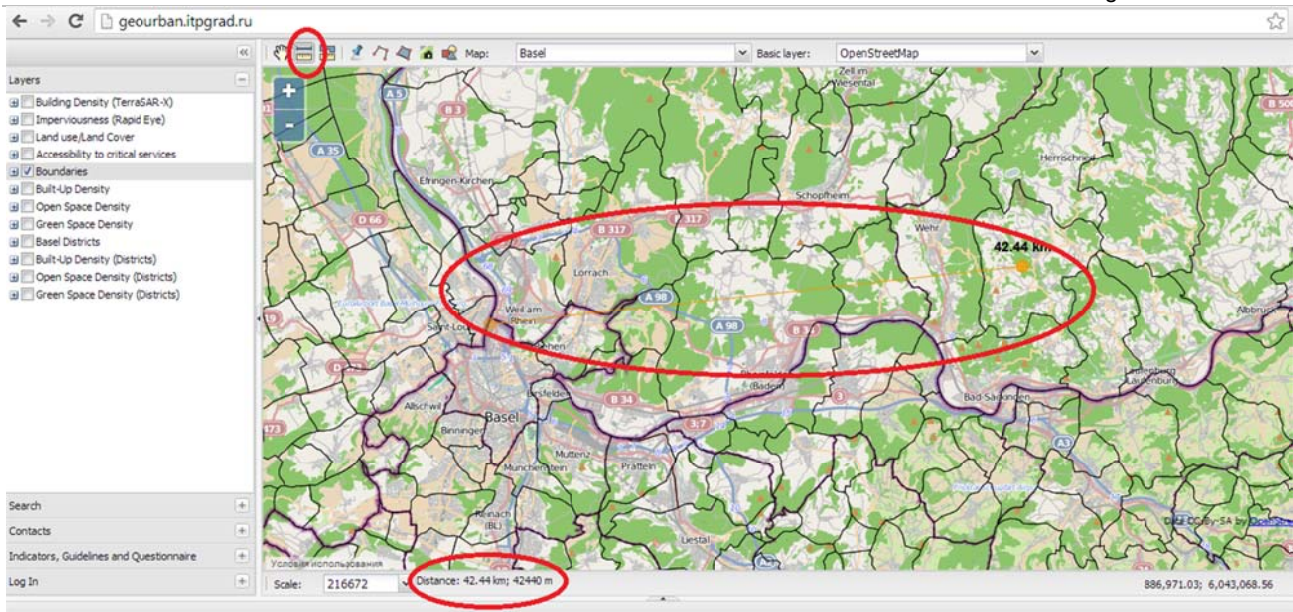Date: 25/11/2013
Page number: 10/23

GEOURBAN

Figure 8. Distance measurement tool

To evaluate the square of polygon there is special tool on the Tools Bar 'Square'. The result displays at the Status Bar in different units.
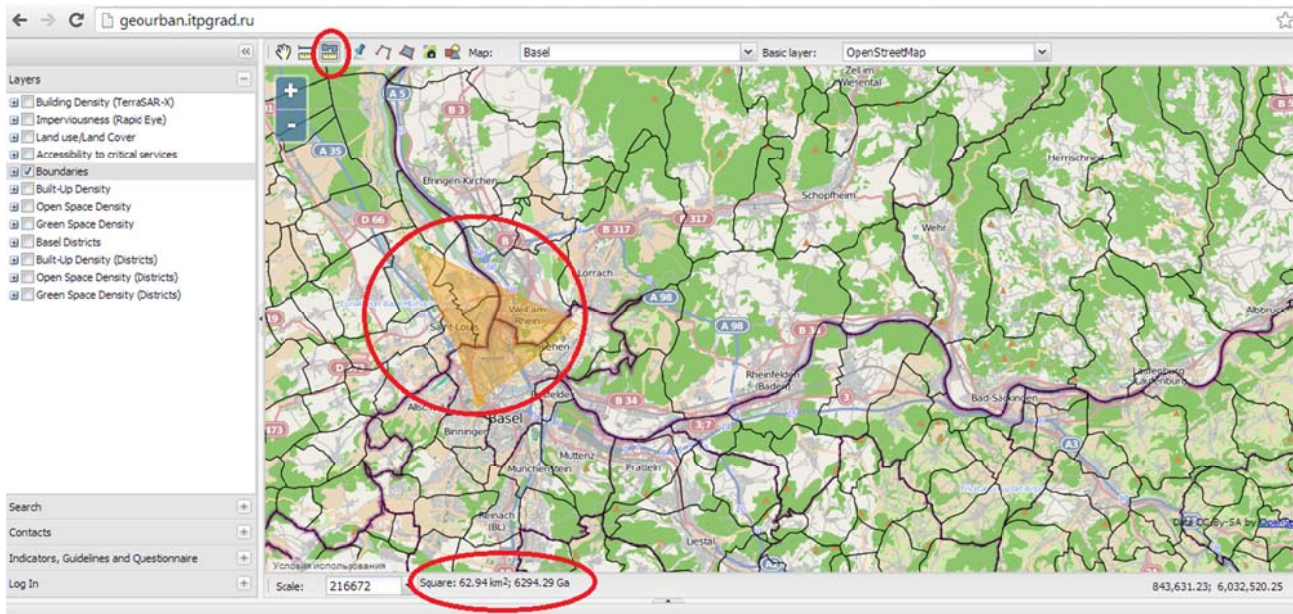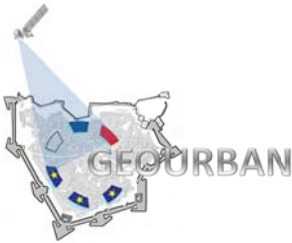

Figure 9. Square evaluation tool

To save map as image switch on needed raster or vector layer or set of the layers and use special button on the Tools Bar. The map will be downloaded in .png image with current scale.

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 11/23

GEOURBAN

Figure 10. Map downloading tool

To save vector layer as file switch on or highlight needed vector layer or set of the layers and use special button on the Tools Bar. The layer will be downloaded in .shp format.
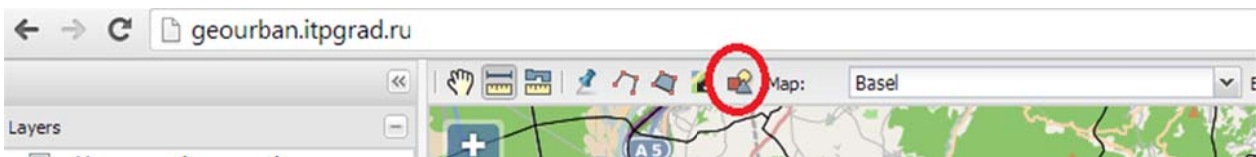
Figure 11. Vector data downloading tool

To create point, line or polygon object use one of the special button on the Tools Bar.

Figure 12. New object creation tools

But only authorized user can save all created objects and send a request for indicator evaluating by defining boundaries.

Functionality of the WIS for authorized user

For creating new object and saving it into the data base with opportunity to evaluate an indicators within its boundaries the user supposed to be authorized. User is available to add on the WIS such object as: point, line,polygon.

For authorization user should register at the WIS.

For registration use 'Log In' menu at the Control Bar (Figure 13) and 'Registration' button.
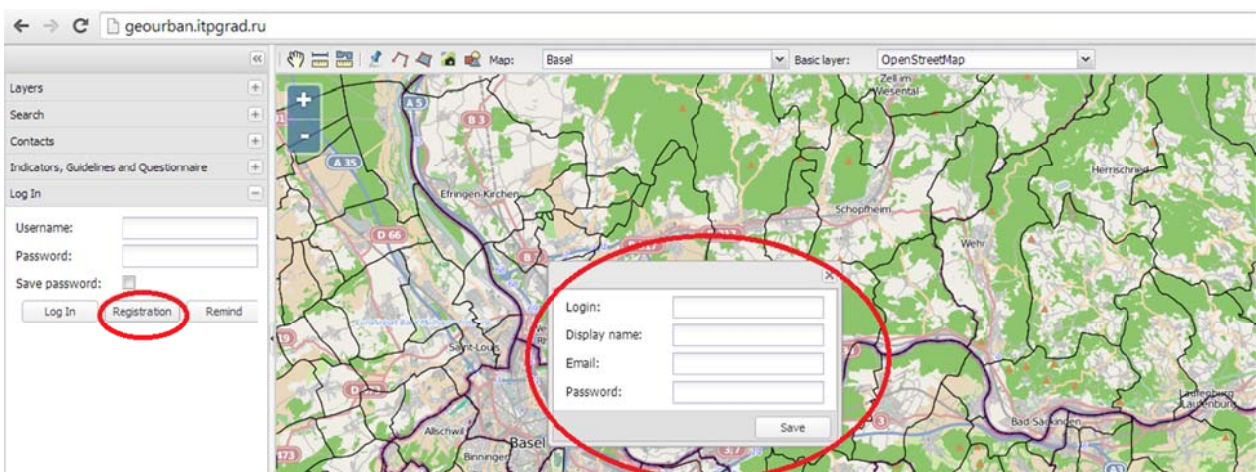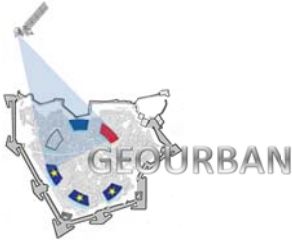
Figure 13. Registration

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 12/23

GEOURBAN

Fulfill all fields and confirm registration by using the link which you will receive by email after registration.

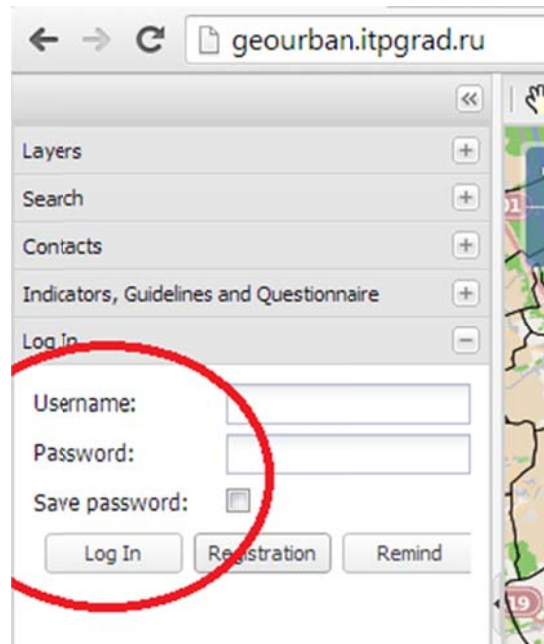**To authorize** use the same menu at the Control Bar.

Figure 14. Authorization

To evaluate indicators see some guidelines in next paragraph.

2.2.4. Indicators evaluation

There are two ways how to evaluate indicators:

1. Using layer with boundaries
2. For user's polygon

The indicator evaluation algorithm by using layer with boundaries includes next processes:

- Administrator of the WIS runs indicator evaluating tool, then fill the form, sets layer with boundaries, browses input raster image and starts evaluation.
- System will put values of the evaluation to data base attribute table for each polygon object (community boundary) and provide color for each polygon according this value.

The process of offline evaluation process is shown on Figure 15.

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 13/23
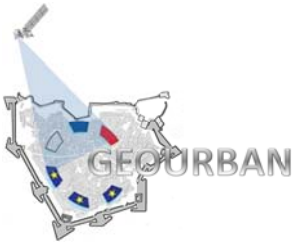
GEOURBAN
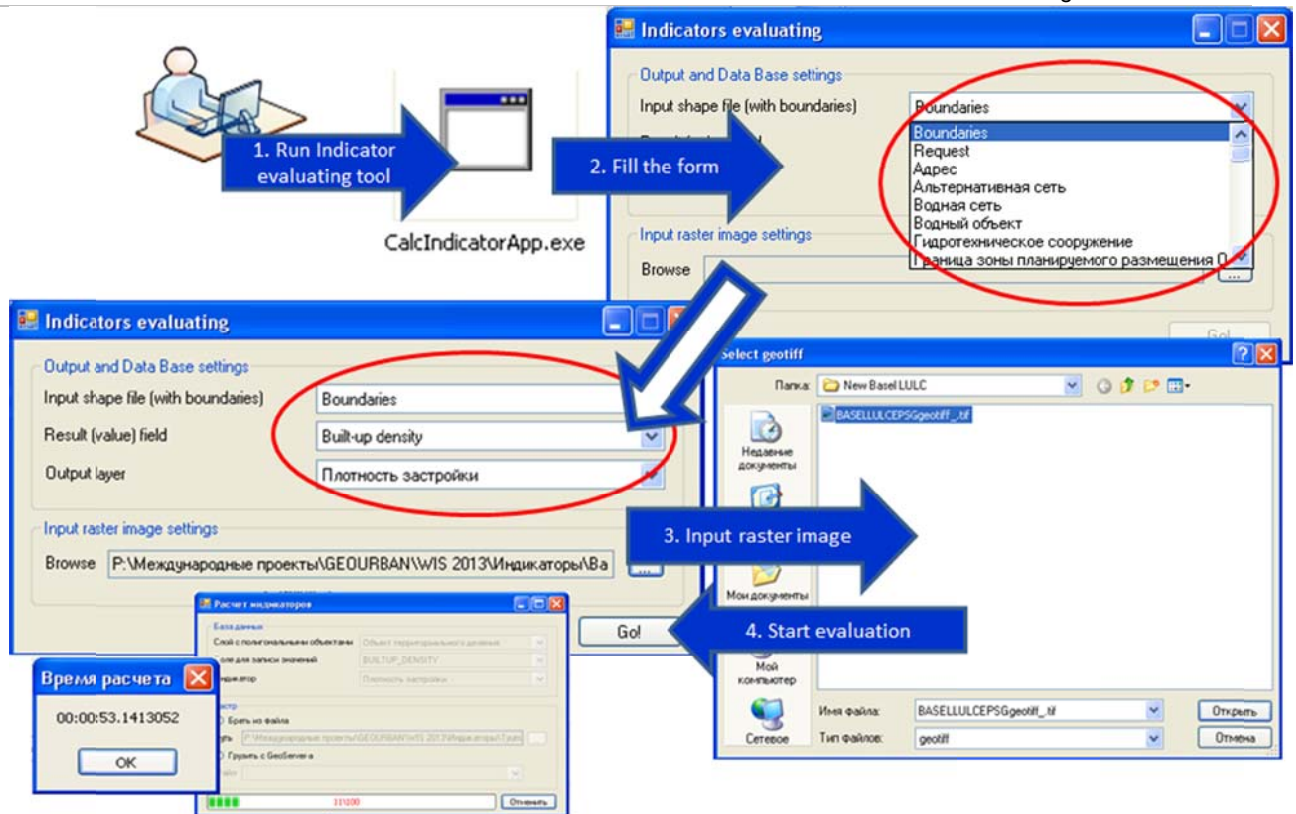
Figure 15. Offline evaluation process

The indicator evaluation algorithm within user's polygon includes next processes (Figure 16):

1. Authorization

2. Switch on editable layer 'User's request'

3. Create new polygon (finish with double click) and **make sure that it is into the Land Use\ Land Cover map boundaries** which will be used for evaluation

4. Chose editable layer

5. 'Save' an object

6. Wait for object creation and evaluation of indicators

7. See the result

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 14/23
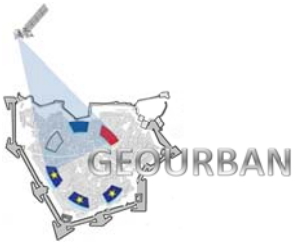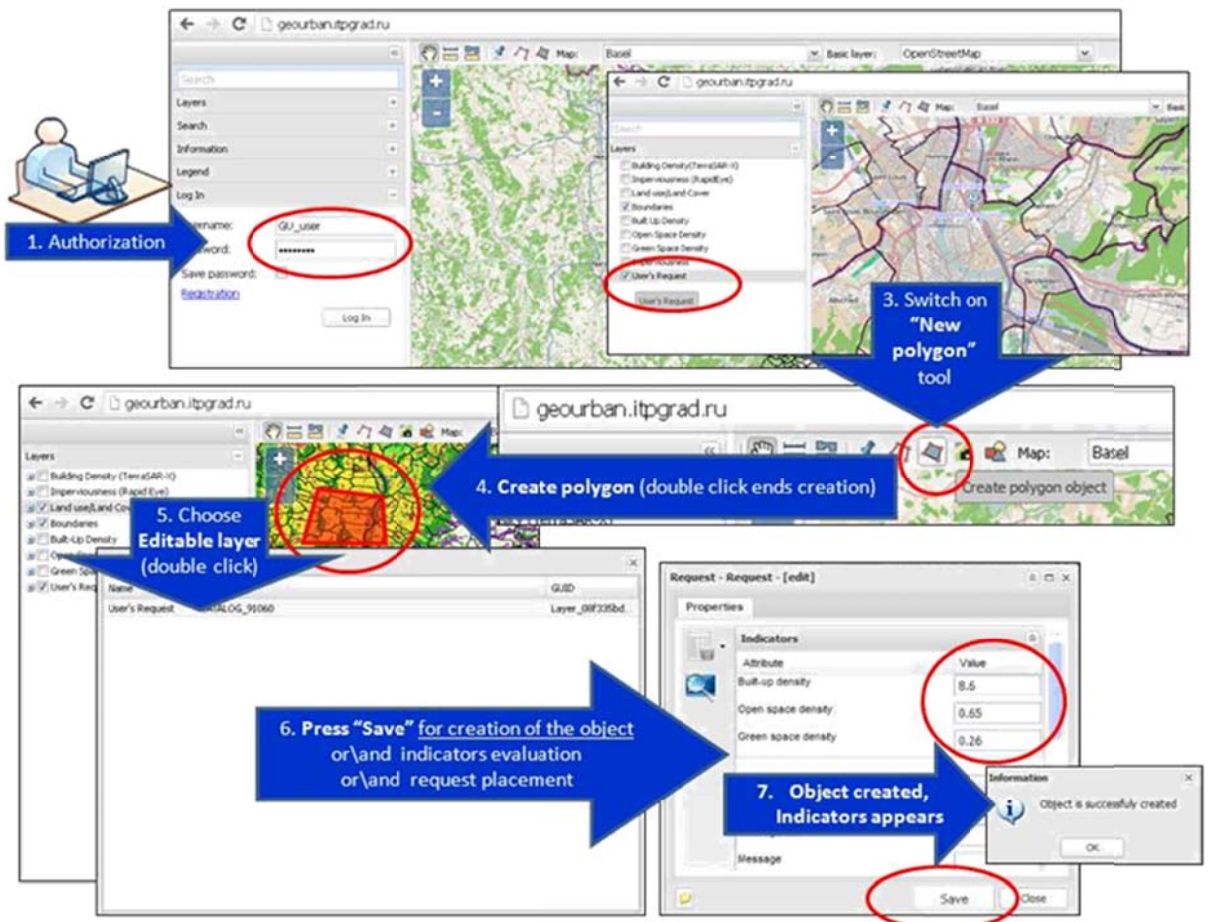
GEOURBAN

Figure 16. Online evaluation process

All steps are illustrated on the figures listed below.
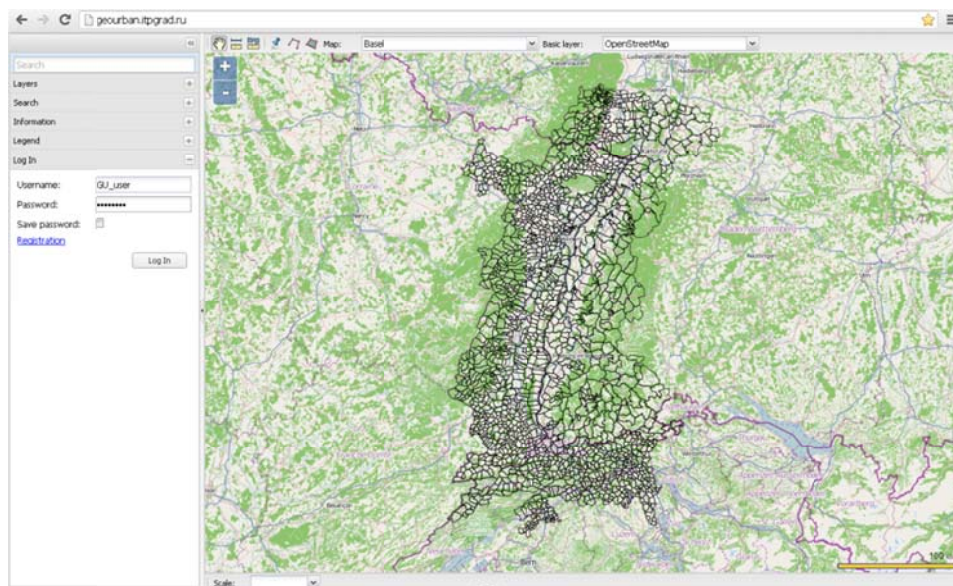
Figure 17. User's authorization

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 15/23
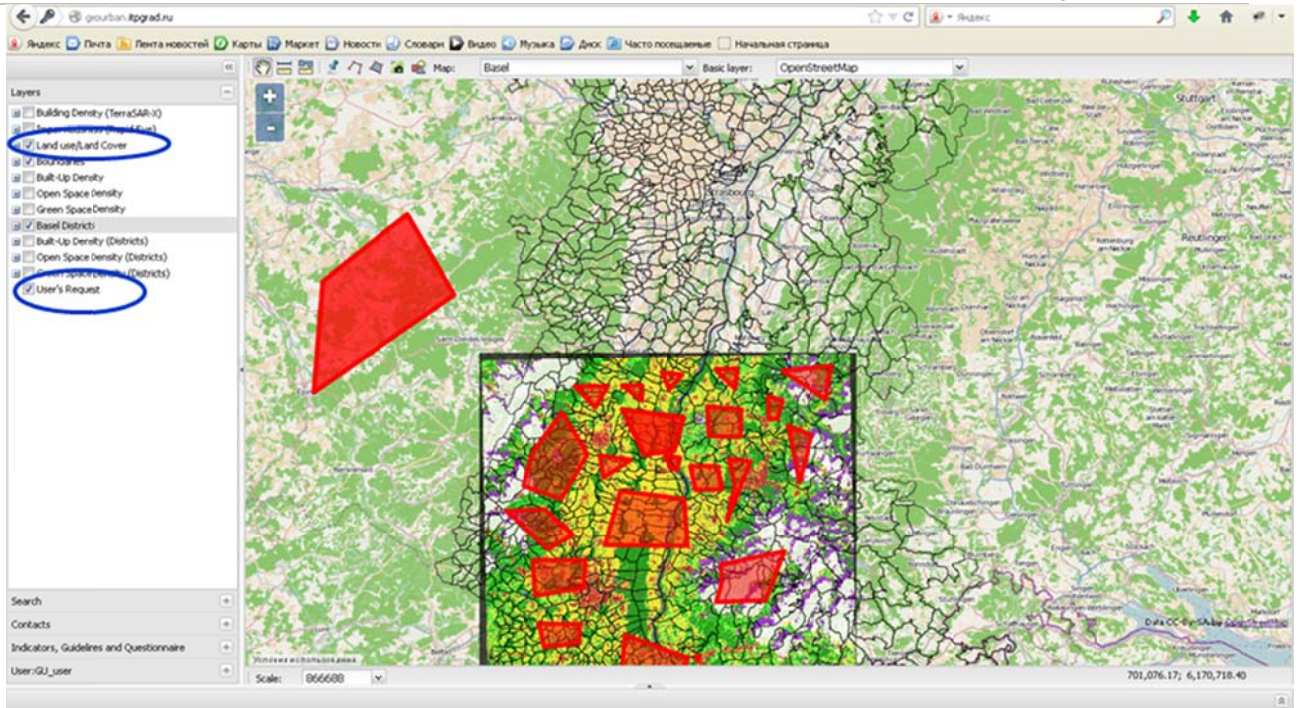
GEOURBAN

Figure 18. Editable layer for creating polygon and Land Use\ Land Cover layer
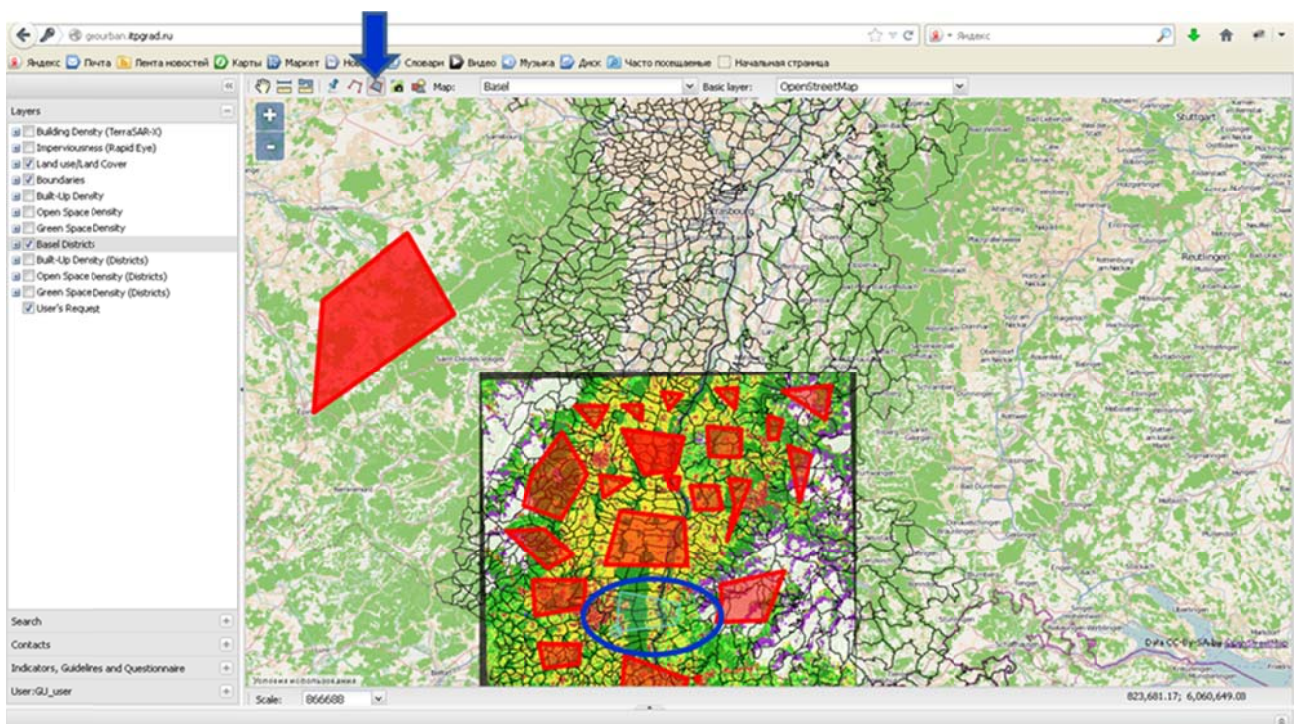
Figure 19. Polygon creation tool and new object

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 16/23
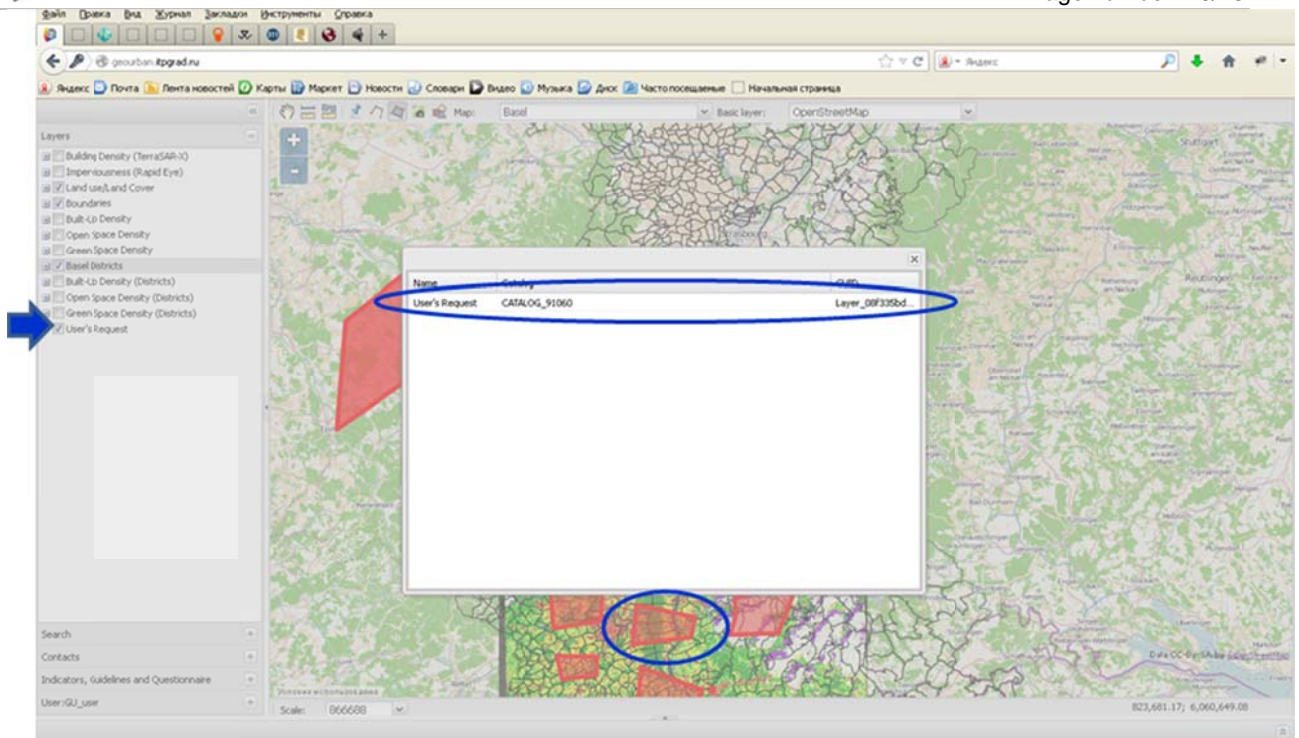
GEOURBAN

Figure 20. Created object and editable layer confirmation

Figure 21. Object's card

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 17/23
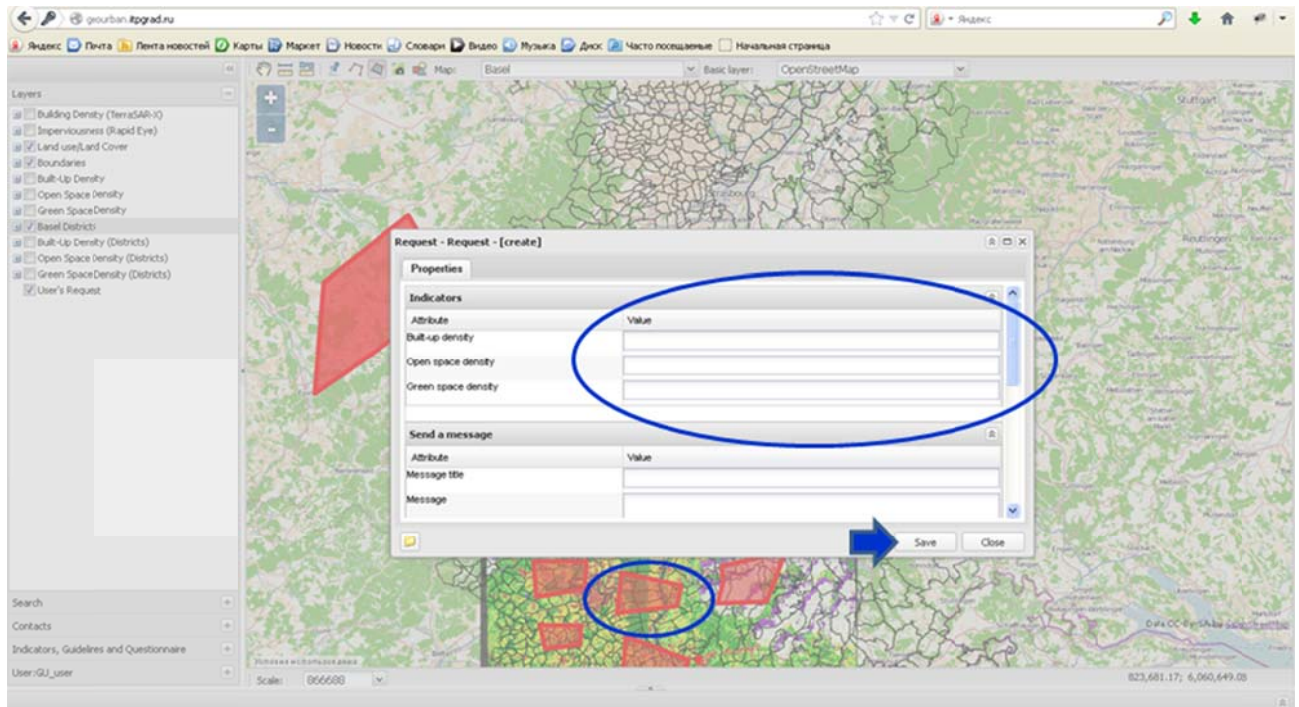
GEOURBAN

Figure 22. Process of the object saving
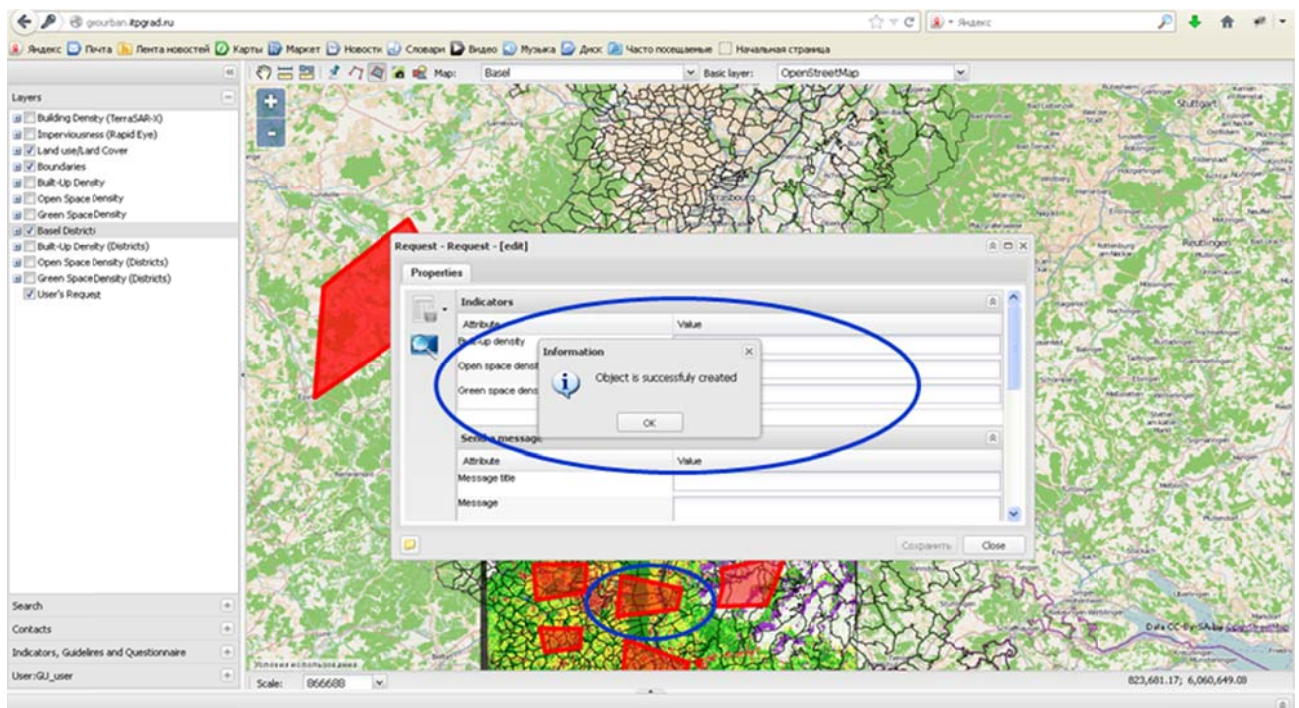
Figure 23. Object is created

WP7: Web Information System
development

Deliverable no.: D.7
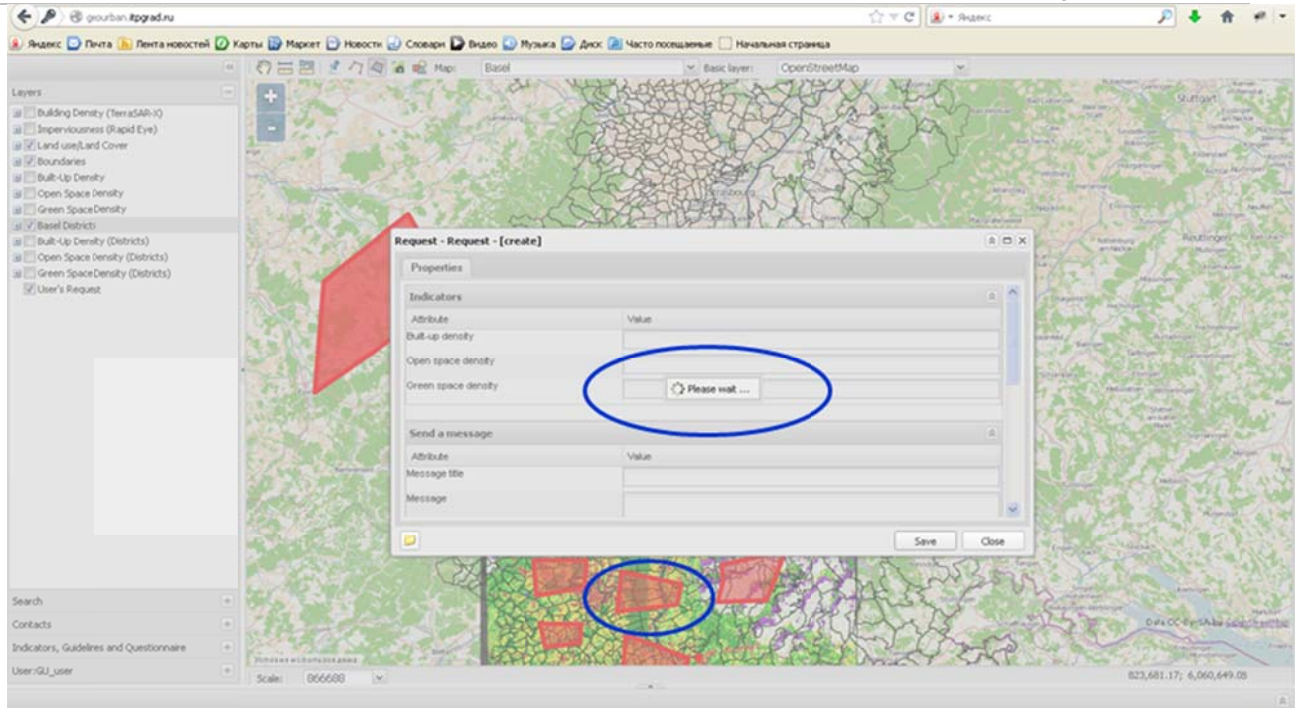Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 18/23
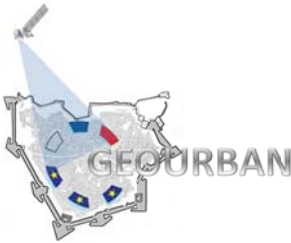
GEOURBAN
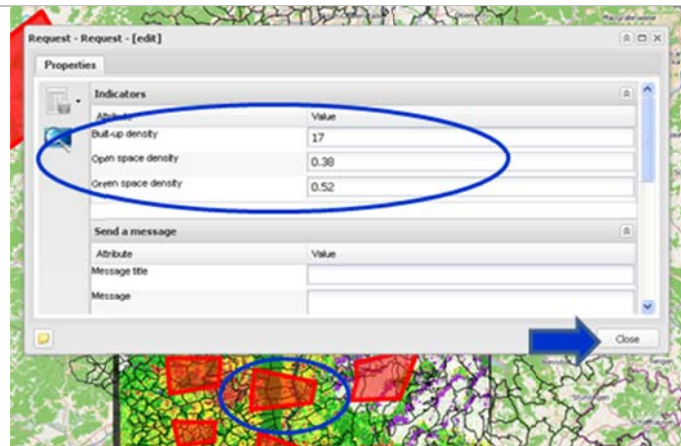
Figure 23. Results of evaluation

The vector-based indicators are extracted by Land Use\ Land Cover map and World View (for Tel Aviv case study) using administrative political community boundaries or city districts (for Basel case study). The value of each indicator is estimated using an appropriate formula within each polygon of boundaries. The vector-based indicators estimated in the current research project are: Built-up density, Open space density, Green space density. The algorithm of evaluation is described in Deliverable D.3 EO-based Indicators Development and shown on Figure 24.

$$\text{Built-Up Density} = \frac{(\text{N\_pixels built-up areas})}{(\text{N\_pixels total})}$$

Figure 24. Algorithm of indicators evaluation (an example for evaluation of indicator 'Built-Up Density', Basel case study)

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 19/23

GEOURBAN

2.3. Functionality of the WIS for administrator

To access the WIS using Configuration mode as Administrator go to http://geourban.itpgrad.ru/administration, username and password are needed. You supposed to be authorized as Administrator before login.
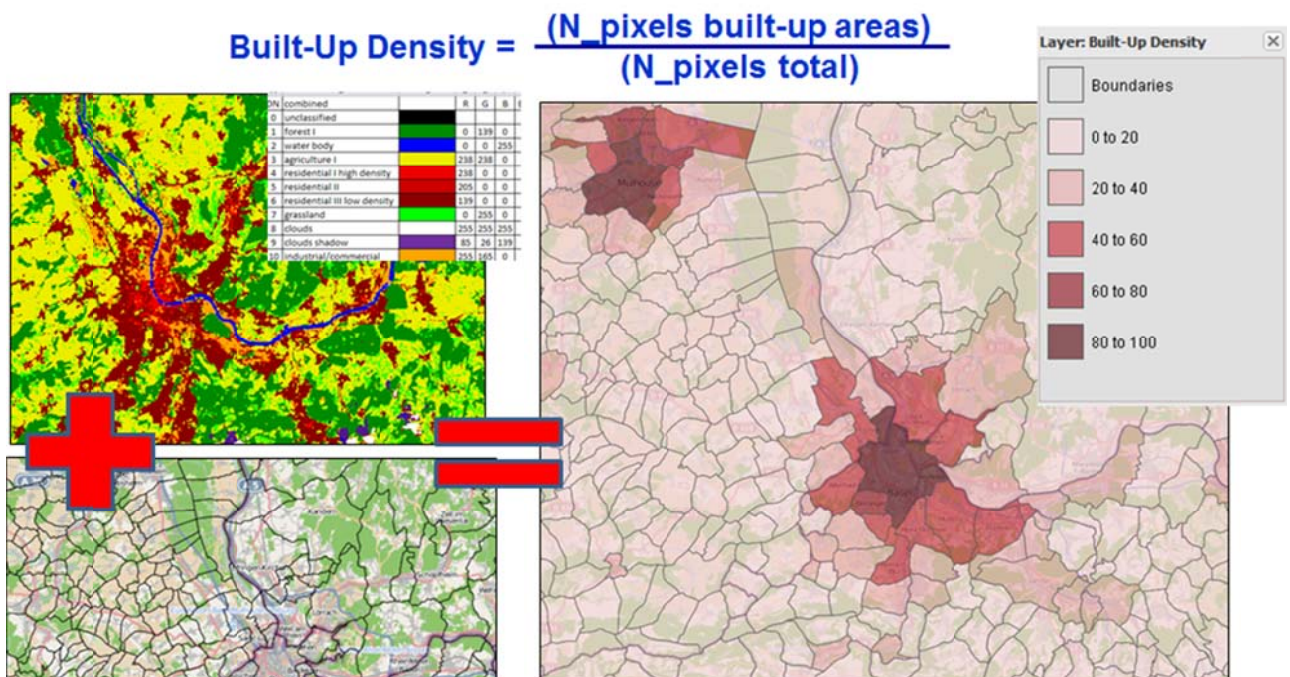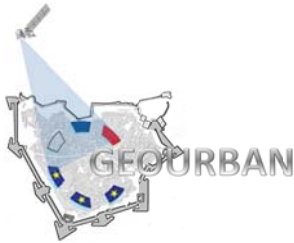
For Administrator besides written above User's abilities there are some permissions to configure the portal:

1. Create, modify and delete access role;

2. Add, edit and delete user account and groups of users;

3. Add and delete data security rule;

4. Manage the storage (Data base or WMS\WFS source);

5. Manage the maps (layers).

6. Create, Edit (Modify) and Delete map (set of layers), layers, group of layers;

7. Create, Edit (Modify) and Delete style using xml (.sld files) setting parameters for the style which chosen from styles list;

8. Delete layer's cache.

3. Data available on the Web Information System

3.1. Data available on the portal

Basel Map (Case Study):

– Building Density (TerraSAR-X);

– Imperviousness (Rapid Eye);

– Land Use\Land Cover (Landsat);

– Accessibility to critical services;

– Boundaries (community) Basel;

– Built-Up Density;

– Open Space Density;

– Green Space Density;

– Basel Districts;

– Built-Up Density (within Basel Districts);

– Open Space Density (within Basel Districts);

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 20/23
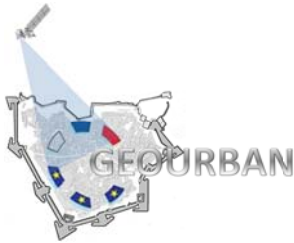
– Green Space Density (within Basel Districts).

Tyumen Map (Case Study):

– Building Density (TerraSAR-X);

– Imperviousness (Rapid Eye);

– Land Use\Land Cover (Landsat);

– Boundaries (administrative) Tyumen;

– Built-Up Density;

– Open Space Density;

– Green Space Density;

– Change detection;

– Fractional land use map – Vegetation;

– Fractional land use map – Imperviousness.

Tel Aviv Map (Case Study):

– Building Density (TerraSAR-X);

– Imperviousness (Rapid Eye);

– Accessibility to critical services;

– Urban Heat Island (June);

– Urban Heat Island (July);

– Urban Heat Island (August);

– Land Use\Land Cover (Landsat);

– World View product;

– Boundaries (administrative) Tel Aviv;

– Built-Up Density;

– Open Space Density;

– Green Space Density;

– Built-Up Density (by using World View);

– Open Space Density (by using World View);

– Green Space Density (by using World View).

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 21/23

GEOURBAN

3.2.	Inputs and data requirements

All data on the WIS is in Mercator map projection (EPSG: 3857). Interactive web maps are using 'Spherical Mercator' system which uses Mercator projection on the sphere.

Requirements for vector data:

Formats: shp, tab, mif\mid.

Attributes: data scheme shall be available with description for each attribute.

Coordinate system in the format Proj4 and WKT (as well as the dimensions of the layer - minX, minY, maxX, maxY).

For layer style creation the values of the field should be provided.

It`s need to provide information about a condition (field + value) and fill color \ line style \ transparency etc.

For polygons and boundaries:

– The number of nodes of polygonal and linear features should not exceed 27,000.

– Square of polygon objects should not be 0.

– Polygons bounders must be 'closed'.

– There should be no self-intersections.

Turning Points polygon and line objects should not be placed closer to each other than those specified in the accuracy of a object (ie, 2 or more points should not have the same coordinates).
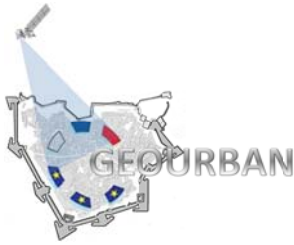
The number of coordinates for the polygon should not be less than 6 (triangle).

Only 2D geometry.

Requirements for raster data:

Formats: geolocated raster image (geotiff, tiff with geolocation file and others formats).

Attributes: value (code) at each point of the raster and the RGB code of colors are used (handbook).

WP7: Web Information System
development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 22/23

GEOURBAN

Coordinate system in the format Proj4 and WKT (as well as the dimensions of the layer - minX, minY, maxX, maxY).

4. Development progress on the Web Information System (WIS)

4.1.　1st release of the WIS

The first prototype of the GEOURBAN WIS created in the beginning of the 2013th. This prototype included a standard set of tools which allow user to manage map switching layers on and switching them off, changing scale and displaying object's attributes such as value of indicator evaluation, measuring distance and evaluating square. The 1st WIS's prototype included Indicators evaluation tool which was used for evaluation of 3 indicators which was evaluated for Basel and Tyumen case studies. There were:

Built-Up Density
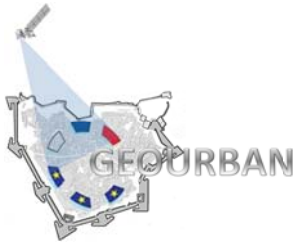
Open Space Density

Green Space Density.

The indicators evaluation algorithms were developed as a fixed set of base mathematical operation with raster input data such as Land Use\Land Cover map with in territorial (community, city districts) boundaries. OpenStreetMap has been used as basic layer on the WIS.

4.2.　2nd release of the WIS

The 2nd prototype was developed in the end of the April, 2013th. There were some appearance improvement and new functional service for the user. For example, users registration and creation new objects: point, line, polygon by using editable layer. This prototype included more data such as raster Land Use\Land Cover map, Building Density (TerraSAR-X), Imperviousness (Rapid Eye) and legend for evaluated indicators layers. Two more basic layers were added: Google satellite and Google hybrid.

4.3.　3rd release of the WIS

1. Appearance improving: separate legend for each layer

2. Implementation of the authorized user's request

WP7: Web Information System development

Deliverable no.: D.7
Contract no.: ERA.Net-RUS-033
Document Ref.: GEOURBAN_39_TR_GRADI
Issue: 1.0
Date: 25/11/2013
Page number: 23/23

3. Data uploading/ vector downloading tools.

4.4. 4th WIS prototype release

1. Appearance improving: new buttons: 'Save map as png' and 'Save layer as file', new into the Control Bar - "Indicators, Guidelines and Questionnaire" menu includes Indicators description and illustration with some Guidelines about on-line indicators evaluation

2. Raster downloading tool

3. Downloading data for Tel Aviv case study

4. Displaying more raster layers with indicators

5. Evaluating and displaying more vector layers with indicators

6. Evaluation of the indicators according to users request on-line

4.5. Final WIS prototype release

Getting user's feedback and fixing bugs, System Description and User's Guidelines preparation during the whole development process and especially before the Final WIS prototype providing. Also more raster layers with indicators are uploaded and styled, and all vector indicators are reevaluated. The current Deliverable D.7 WIS Development is provided.