A Yandex Map-based geo service for visual analytics

Young researcher's note

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***Abstract* – The paper deals with the development of a visual analytics tool based on Yandex.Maps. The necessity to use geo services for energy research, in particular, in studying critical infrastructures with the help of visual analytics, is illustrated. Consideration is given to the specific features of geo services including their multilayer, multiscale and multiangular nature. The design of a new visual analytics tool based on Yandex.Maps is described. An important aspect of this development is the ability to import KML files. The implementation of the new tool prototype is demonstrated with a specific task. The additional possibilities of this tool are considered. The developed tool of visual analytics can serve as a decision support tool for analytical and predictive research in the energy sector to assess both the current state of the energy infrastructure and the conditions for the adoption of a potential development option.**

***Index Terms* – geovisualization, Yandex.Maps, Geo services, KML.**

I. Introduction

To study the energy sector as a critical infrastructure, it is advisable to use methods and tools of visual analytics and cognitive graphics.

Critical infrastructure is part of the civil infrastructure that represents a set of physical or virtual systems and means that are important for the state to the extent to which their failure or destruction can lead to disastrous consequences for the defense, economy, health care and the security of the nation.

Energy infrastructure is a set of physical or virtual systems that represents information about the production, generation, transmission, or distribution of energy.

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Visual analytics is understood as an opportunity to think analytically, supported by a graphical interface [1, 2]. In other words, it is a human-machine system where functions are distributed between a human and a computer [3].

Geo services found their use in presentation of a set of objects and groups of objects in the context of geospatial coordinates. They represent the services on the Internet intended for working with geospatial information. The Melentiev Energy Systems Institute (MESI) SB RAS is engaged in the research on visual analytics and cognitive graphics [4, 5], which has been recently conducted within the concept of "Digital Land" [6].

MESI SB RAS uses both traditional GIS, for example, [7, 8], and geo services of Google Earth [9, 10] to study and substantiate geospatial problems [5, 11, 12], including the research into the energy sector as a critical infrastructure [13].

II. Geo services: basic concepts

The use of geo services as tools for visual analytics offers a number of advantages. These are their multilayer, multiscale and multiangular nature.

Multilayer means the ability to arrange groups of objects in a form of layers on the map, which can be controlled separately. This advantage greatly expands the possibilities for analytics, in particular, it becomes possible to create samples from different groups of objects, build a hierarchy of objects, add additional layers necessary to analyze objects in the tasks related to the energy sector and energy systems.

Multiscale implies the ability to analyze and present the situation for different levels of display without distorting the information in a wide range of scales - from global to super-detailed.

Multinagular means the ability to position the observer's camera relative to the surface at any angle. This makes it possible to choose an angle that enables an object or a group of objects to be displayed in the most perceptible form or to focus on a certain part of the image.

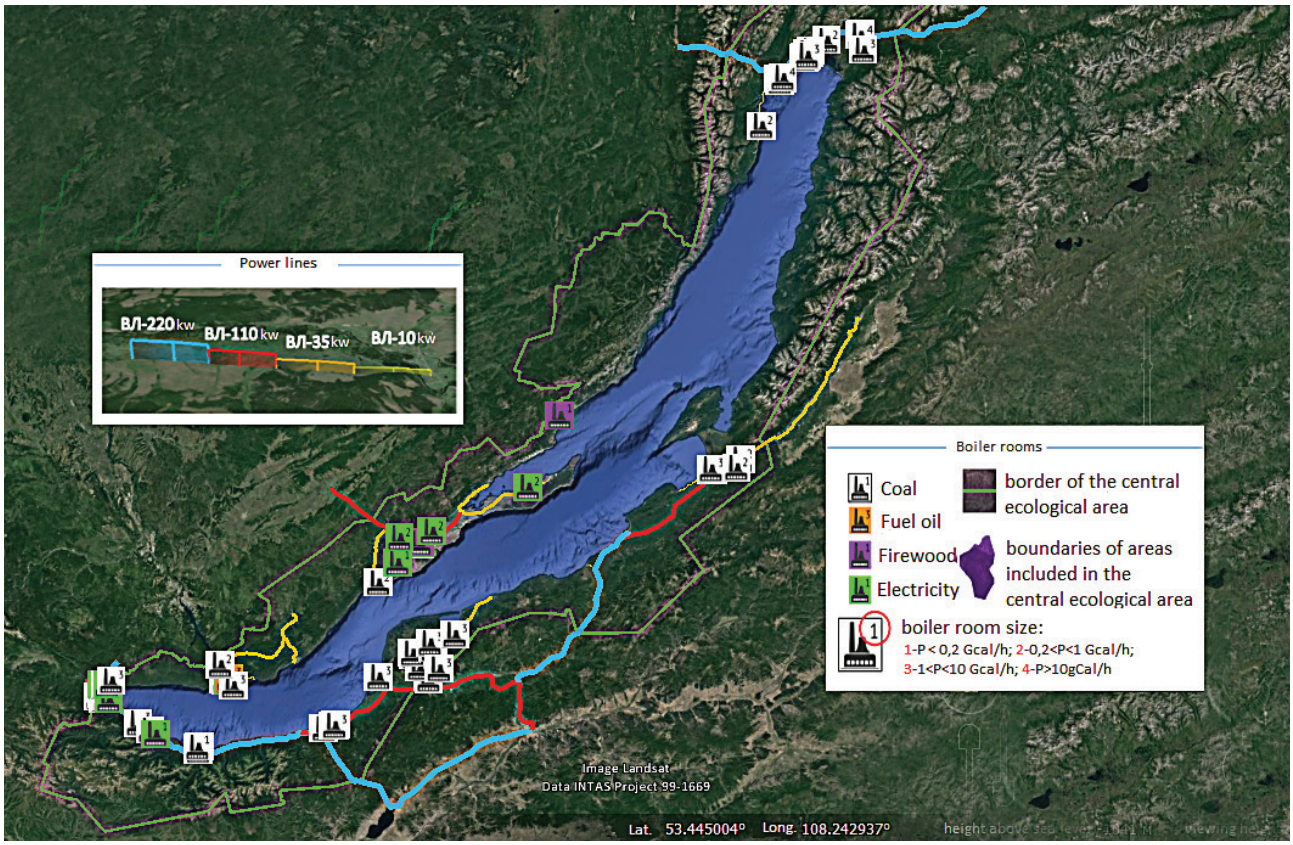

Fig. 1. Display of energy infrastructure of the central ecological zone of Lake Baikal with Google Earth.

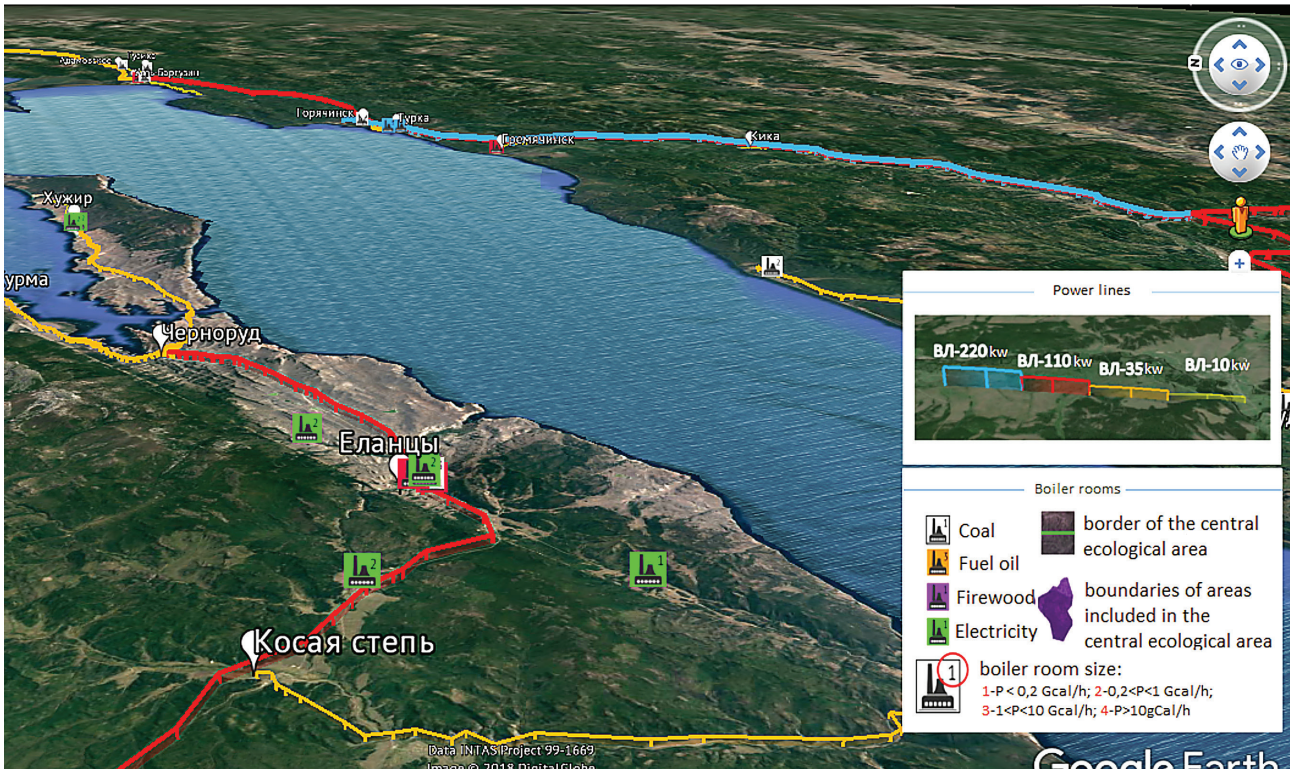

Fig. 2. An enlarged fragment of the central basin of Lake Baikal from a different angle.

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            </Point>
          </Placemark>


          <Placemark>
            <description>Boiler room №2, г. Бабушкин

Installed capacity 1,81 Gcal/h

ООО &amp;quot;Комфорт&amp;quot;</description>
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Fig. 3. Part of importing KML file.

The above–described properties (Fig. 1 and Fig. 2) help organize the display of various information depending on the objective for any territorial level.

The Melentiev Energy Systems Institute SB RAS has developed a Geocomponent to work with geo services. It works through the Google Earth API with the KML geospatial data format [9, 10, 14] that was used to obtain these illustrations.

III. Design of a tool based on Yandex.Maps

Access to the Google Earth API was closed. This is why it was decided to use Yandex.Maps API to restore functionality. The goal was set to develop a visual analytics tool, similar to Google Earth, based on Yandex.Maps.

To achieve this goal, it was necessary to accomplish the following tasks:

1. Analyze the Yandex.Maps API capabilities to create a geo service based on it.
2. Develop a prototype of a visual analytics tool based on Yandex.Maps with the ability to import KML files.
3. Analyze additional features of Yandex.Maps for visualization and their use in this tool.

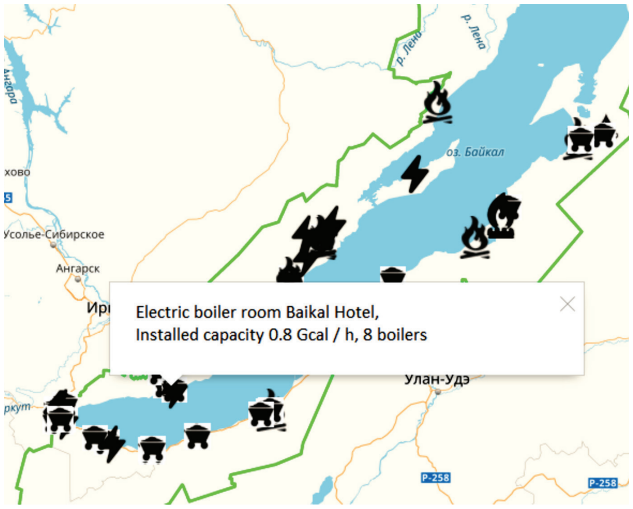

Fig. 4. Mapping of the energy infrastructure of the central ecological zone of Lake Baikal by the Yandex.Maps service.

The Yandex.Maps service provides a convenient interface and technical support for integration with current research. It is used as a basis for the development of a tool to display geospatial information for energy research.

The Yandex.Maps service retains the basic principles, such as multiscale and multilayer nature of display. The service makes it possible to install a plug-in into your own application and work with it through the Yandex.Maps API.

IV. Implementation of a tool prototype

The prototype of the visual analytics tool based on Yandex.Maps was developed using HTML and JavaScript. This prototype provides the ability to import KML files using images.

The KML file specifies a set of features (placemarks, images, polygons, 3D models, textual descriptions, etc.) that can be displayed on maps in geospatial software implementing the KML encoding (Fig 3).

To load a map in KML, Yandex should process this file on the server side, because the Yandex.Maps API works like a JavaScript plug-in and does not provide local processing of KML and XML formats. In addition, you need to make sure that the Yandex.Maps API is able to load all images that are referenced in the KML file. Mapping of the energy infrastructure of the central ecological zone of Lake Baikal with Yandex.Maps service is shown in Fig. 3. This map shows the central ecological zone of Lake Baikal, the locations of boiler plants that use different fuels and their power output.

Moreover, the Yandex.Map API offers a wide range of functions for different kinds of visualization that will be added to the developed tool, including:

4. The use of panoramic pictures (360-degree images), which can be viewed in the interface of the map.
5. The creation of automobile, pedestrian and arbitrary routes.
6. The assignment of events for objects, i.e. a change in the parameters of the objects associated with timestamps and animation.
7. Visual clustering, i.e. collection of several placemarks in one area when zooming.
8. Filtering of objects by their parameters.
9. Forward and reverse geocoding, i.e. identification of an object by coordinates and vice versa.

V. Conclusion

The visualization of information by geo services through the use of realistic maps of the earth's surface (space and aerial photographs), in conjunction with the three-dimensional model of the globe, makes it possible to move to a new level of information presentation, owing to new opportunities for mapping geospatial information.

Therefore, it is the basis for the development of the tools intended to support decision making, both for the researcher, expert, and for the representatives of energy companies or authorities. The developed visual analytics tool can serve as a decision support tool for analytical and predictive research to assess both the current state of the energy infrastructure and the conditions for the feasibility of adopting a potential development option.

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