

Using GIS-Technologies for the Water Objects Monitoring in the Area of the Olympic Games in Sochi-2014

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Abstract¹

The article discusses a geographic information system presenting information about water objects in the zone of the Olympic Games in Sochi – 2014 which is used to provide information support for decision-making of the central office staff of Federal Agency of Water Resources in Moscow, Kuban Basin Water Agency staff in Krasnodar and its territorial department in Sochi.

1. Introduction

Water as a variety of natural resources play an important role in the development of Russian economy, so the rational management of water resources is one of the primary tasks of life-sustaining state. Water resources management in Russia is controlled by the Ministry of Nature and Environment and the Federal Agency of Water Resources (Rosvodresursy) [1]. Because of the spatial extent and distribution of water facilities throughout the Russian Federation geographic information system technology is proposed to be used. Therefore, for the automation of many tasks in water resources management we develop corporate geographic information system (GIS Rosvodresursy), which main goal is to provide a GIS user with the consistent, reliable, relevant and accurate spatial, reference and analytical information for water resources assessment and decision-support of operational and strategic decisions on water management in Russian Federation.

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2. Geographic information system of Federal Agency of Water Resources

GIS Rosvodresursy covers all levels of management (federal, basin and territorial) [2]. It was originally implemented on the basis of software ArcGIS Desktop and ArcIMS. But the growing information needs of employees demanded the transition of the system to a new server technology: the ArcGIS Server [3]. An Internet GIS application Rosvodresursy has been developed. It includes the geodatabase, user and programming interfaces for interaction with other information systems of Rosvodresursy, as well as the following subsystems (fig.1):

1. Subsystem of modelling spills and distribution of oil and oil products in water bodies and the threat of their falling into the water bodies.
2. Subsystem of complex analysis of water resources in Russia.
3. Subsystem of zoning Russian Federation territory by the range of indicators that characterize the impact and the state of water objects.
4. Subsystem of flood zones' modeling for the determination of places most vulnerable to flooding during the flood period, an assessment of the risk associated with the floods.
5. Subsystem of reporting the results of modelling.
6. Subsystem of reference and search tasks.
7. Subsystem of federal reservoirs.
8. Subsystem of integration with information system of analyzing critical situations, etc.

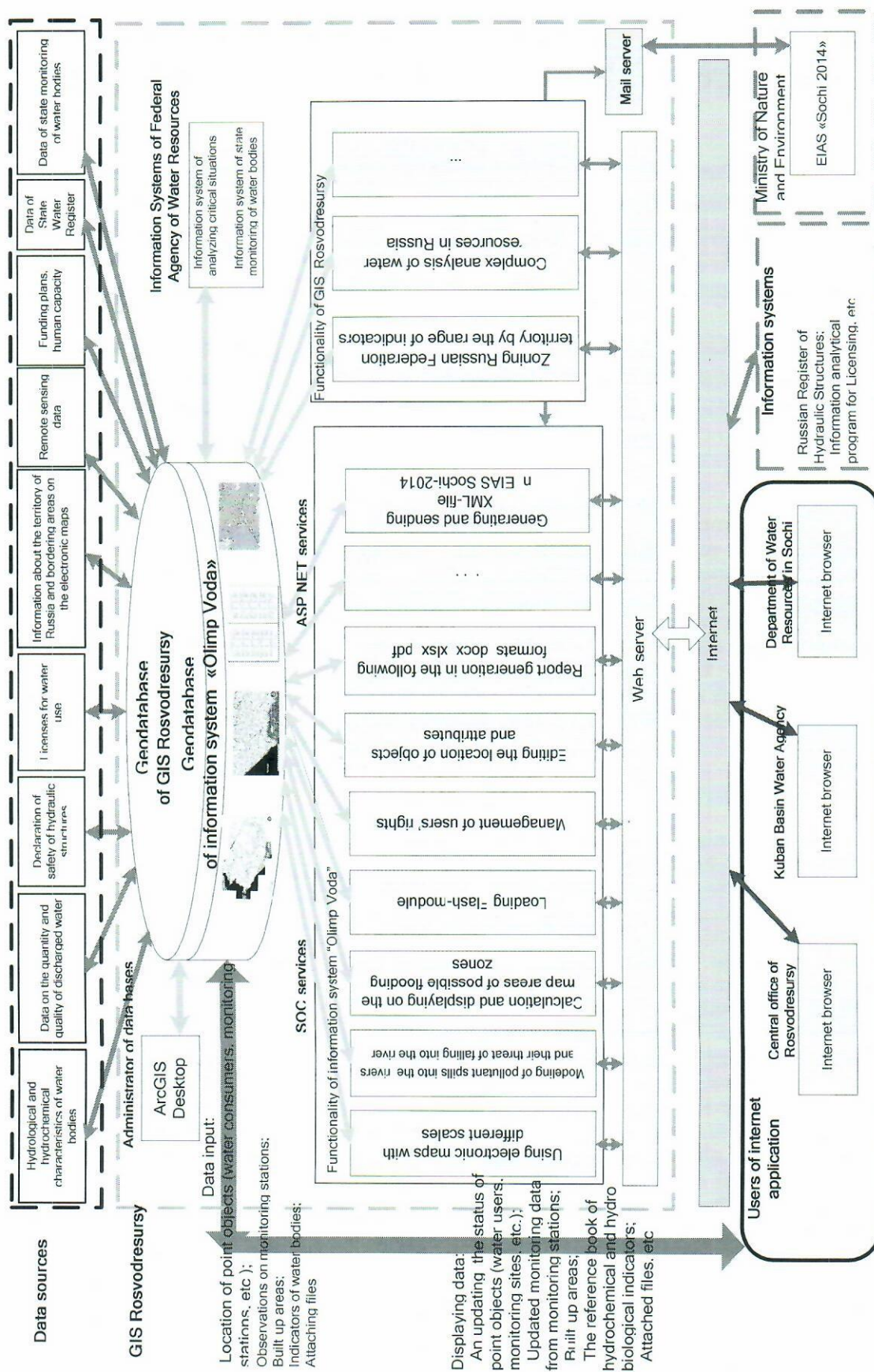


Fig. 1. Structure of GIS Rosvodresursy

2. Geographic information system "Olimp-Voda"

In connection with the preparation and control of the XXII Olympic Winter Games and XI Paralympic Winter Games 2014 in Sochi, the staff of Ministry of Nature and Ecology and Rosvodresursy needs to receive information about the state of the environment, including the status of water bodies. Construction of Olympic facilities, roads and other infrastructure could lead to industrial pollution, depletion of water resources, reduction of farmland and recreational areas. Therefore it is important to monitor the status of water bodies during the preparation and holding of the Olympics, the results of which will take operational decisions on water protection from depletion and pollution. Development an information system for reporting information about the state of water bodies in the zone of the Sochi Olympics-2014 (Olympus IS-Water) allows to effectively solve this problem.

Information System "Olymp Voda", developed as a part of GIS Rosvodresursy is used to provide information support for decision-making for the management staff of the Federal Water Resources Agency in headquarters, the Kuban Basin Water Agency management and its

territorial departments using the system via the Internet (fig. 2).

The information system "Olymp Voda" has the following functionality; some of which has been transferred from the desktop and Internet GIS application of Rosvodresursy:

1. The task of displaying electronic maps of various scales for the area of the Olympic Games as well as raster remote sensing data (Fig. 3) has been solved. The basic functionality of the map has been implemented: the displaying and changing the current scale of the map, navigation through the maps, the selection an object on the map and displaying all information about it, printing out the current area of the map, measuring distances and areas.
2. The functionality of the previously used in a desktop GIS project subsystem of reference and search task has been expanded by realizing the following: searching of human settlements and water bodies by name or its fragment, displaying a list of found objects with the possibility of allocation on the map selected in the list of objects and view information about it.

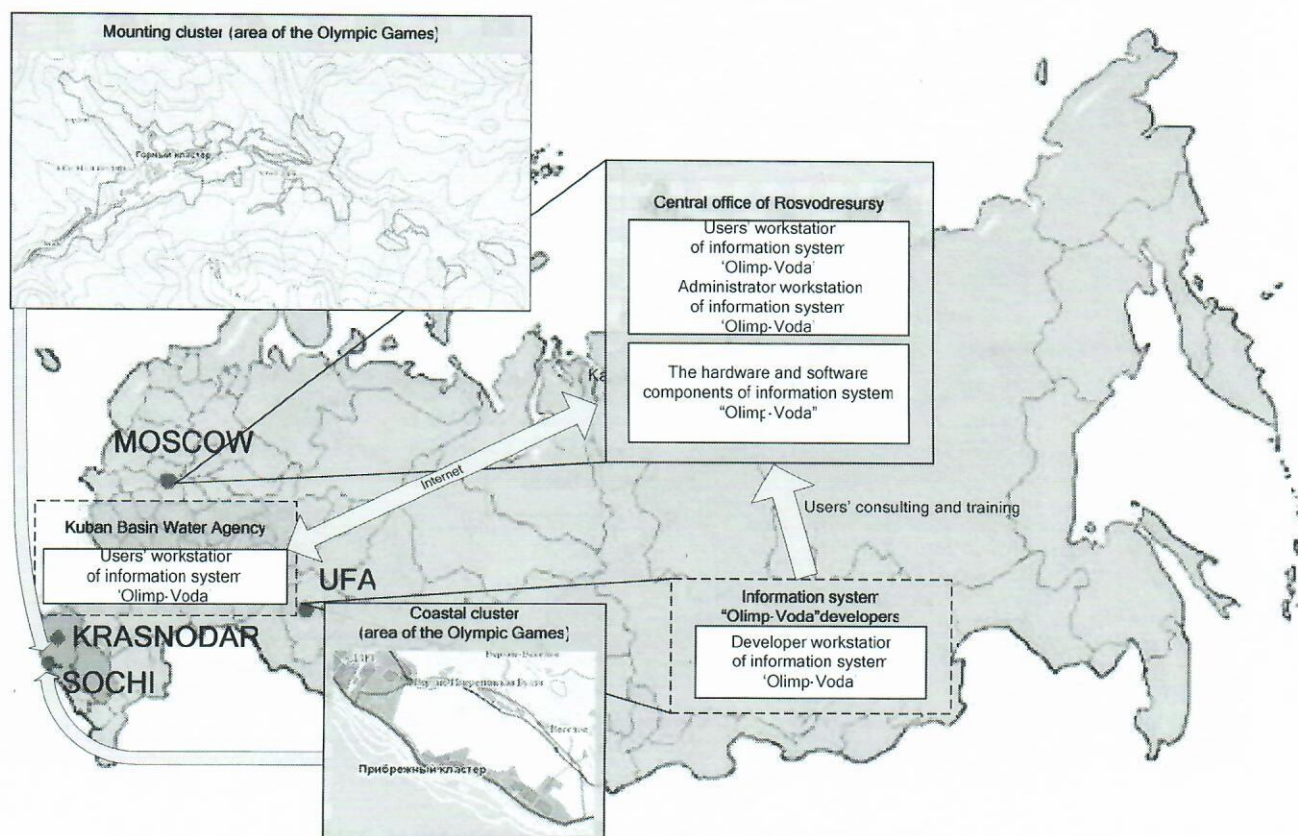


Fig. 2. Scheme of functioning information system "Olimp-Voda"

The information is displayed in the form of an information card that contains: general information about the object; observational data of the water bodies in the monitoring stations in the form of tables and graphics with the possibility of choosing hydrochemical and hydro biological indicators and the time interval; getting the additional information about the object, for example, regulations, photos, and others in the files of any format. The user can export the data of observations on the state of water bodies in the form of tables in Excel, graphics or reports in Word. The reference book of hydrochemical and hydro biological indicators has been designed for the user convenience, which allows a user to view information on the indicators, the values of maximum permissible concentration, units of measurement.

3. A subsystem for input and elaboration on the map the following types of point objects: water users, monitoring posts (hydrological posts, hydrochemical observation points, hydrobiological observation stations, hydrochemical indicators of marine water); hydraulic structures, objects which have a negative impact on surface water bodies; etc. This subsystem

allows a user with appropriate rights to add, edit and delete the point objects in a geodatabase.

4. The possibility of generating reports and graphs, which can show the dynamics of change in a certain controllable parameter (hydrochemical, hydrological or hydrobiological) at selected monitoring sites over time (Fig. 4), as well as to conduct a comparative analysis of several indicators is realized in the information system "Olymp Voda". With the functionality of "Comparison of measurement" a user can identify the modification of indicators' pairs at the selected monitoring posts. For example, increased water consumption usually leads to a reduction of the concentration of pollutants. Also in the information system "Olymp Voda" a task of automated geocoding of water users from the document State Water Register on the map scale 1:200 000 has been solved. In the case of changing water user location on the map a function of editing the location and entering information into an information card is implemented.

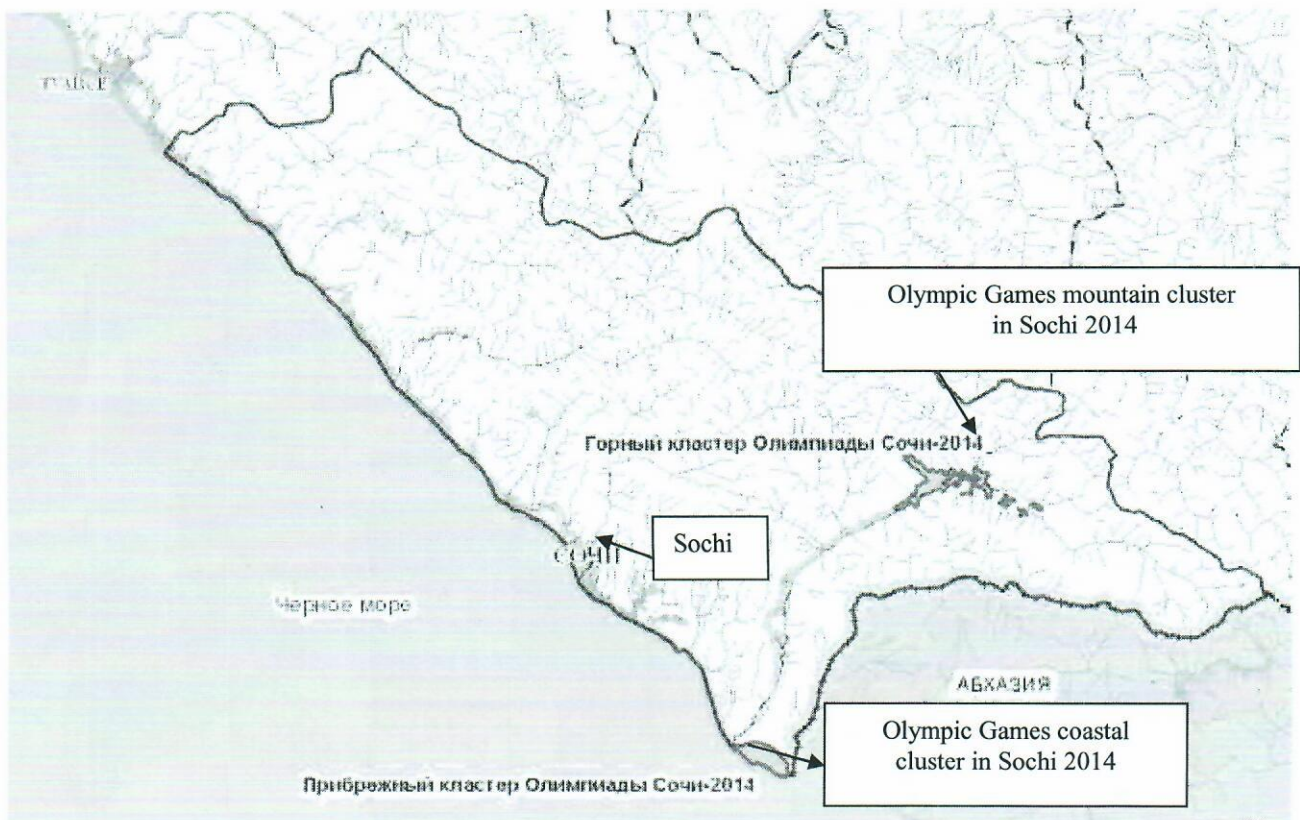


Fig. 3. Map of the Olympic Games area in Sochi, 2014

5. A subsystem of developing possible flooding zones is expanded in comparison with desktop project of GIS Rosvodresursy, which allows to estimate the flooded areas and objects due to heavy rains.
6. A subsystem of modeling of pollutant spills in rivers and the threat of falling into the river is designed to solve the following tasks on the territory of Sochi: modeling and displaying on the electronic map the spread of oil and oil products in the river network; modeling of the pollutants' distribution in the river network and the forecast of distribution of the concentration of substances for the following substances and group of substances of the chemical composition of water: the content of copper, phenol, iron, nickel, etc. Besides the subsystem allows to assess the spread of contaminants (oil, oil machinery, diesel fuel, fuel oil, gasoline) by the threat of falling them into the river.

Challenges of the information system "Olymp Voda" are solved using standard web services (mapping and geoprocessing services) and Web services ASP.NET, using ArcObjects and ArcSDE data and ArcGIS Server. Hardware and software components of the information system: geo-database and a set of services that implement the tasks of information system are located in the central office Rosvodresursy (Fig. 1). Requesting to the services is performed through a Web server over the Internet. On the workplaces of information system users should be

installed Microsoft Windows, Web browser with additional software Flash Player, and should be an access to the Internet.

Thus, in the information system "Olymp-Voda" is solved the following tasks such as remote data entering; classification, storage of cartographic, attribute, and additional information about the waterbodies in the area of the Olympic Games, various types of data retrieval, modeling of accidental spills of pollutants in rivers and under threat of falling into the river, the calculation and display on the map areas of possible flooding, building and mapping schemes of monitoring stations, analysis of changes over time of built-up areas and borders of forest zones, the mapping of remote sensing data of the Olympics, as well as data transmission into information-analytical system (EIAS) Sochi-2014 functioning in Ministry of Natural Resources and other information systems.

4. Conclusion

Information System "Olymp Voda" has been developed using GIS technology and satisfies the information needs of both management and specialists in the domain area of water resources: in Kuban Basin Water Agency, water department in Sochi and in the central office of the Federal Agency of Water Resources (in Moscow).

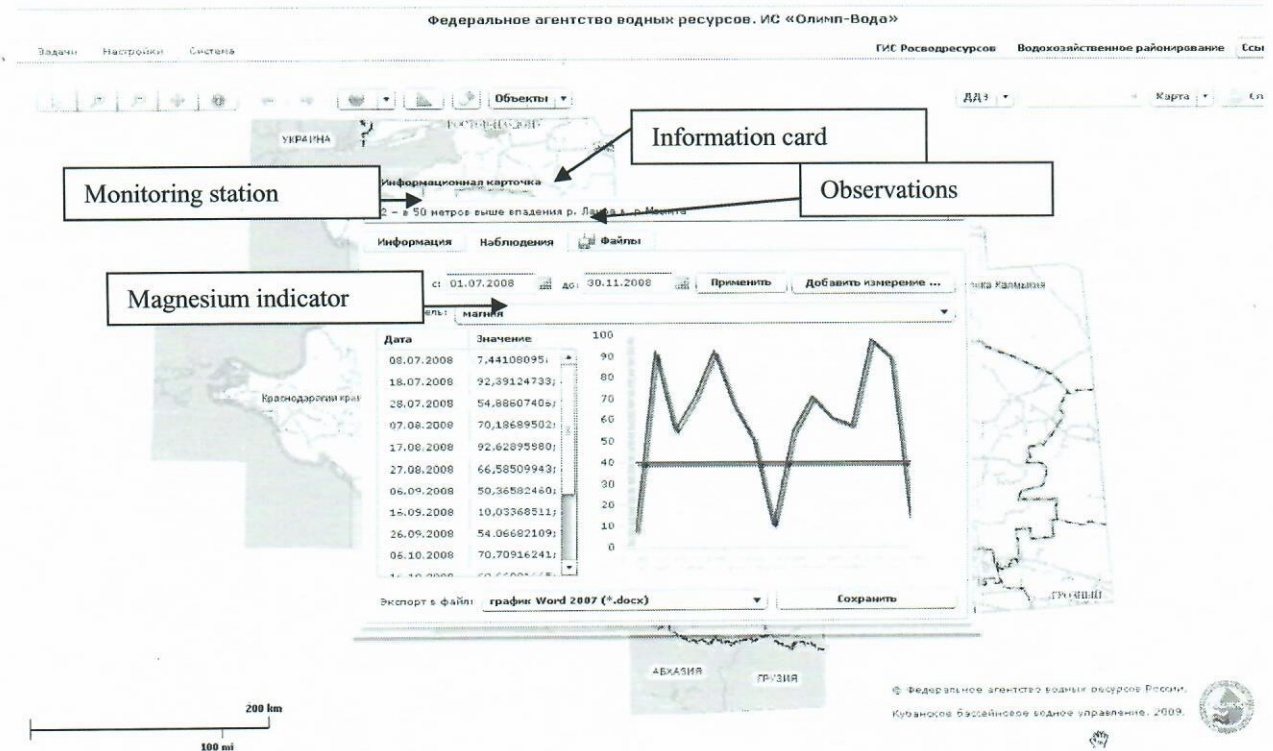


Fig. 4. Report on controllable parameters (magnesium) on the selected monitoring station for a given period

Information system “Olipm Voda” is developed for the preparation of the results of monitoring the state of water bodies, which allow to apply complex spatial and attributive dependency analysis of various indicators and geographic location. This system is implemented as a web application based on service-oriented architecture and requires no special software to customers - employees of the central office of Rosvodresursy, Basin Water management and territorial departments.

References

1. Nikitin A. B., Pavlov S. V., Khamitov R. Z. “Geoinformation system of the Federal Agency for Water Resources”. In: ArcReview, № 1 (36), LLC Date +, 2006. pp. 6–7.
2. Pavlov S. V., Khamitov R. Z., Khristodulo O. I. “Creation of Corporate Geoinformation System of Federal Agency of Water Resources”. In: Proc. of the 6th International Workshop on Computer Science and Information Technologies (CSIT’2004), Budapest, Hungary, 2004. Vol. 2. pp. 62–66.
3. Ivanov I. G., Pavlov S. V., Nikitin A. B., Abramov S. A. “Organization of spatial data sharing in distributed GIS Rosvodresursy based on ArcGIS Server”. In: ArcReview, № 4 (47), 2008.