State Research Center of the Russian Federation “VNIIgeosistem”

Dubna International University

Russian Site of the
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Industry-University Research Center for Advanced Knowledge Enablement

Application of advance GIS technologies to environmental monitoring

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GIS-TECHNOLOGIES FOR ENVIRONMENTAL MONITORING

Main fields of application:

• **Data analysis:** spatial analysis of geo-data for assessment or modelling of processes and situations

• **Data management:** storage and systematization of vast volumes of monitoring data, development of databases and applied computer systems

• **Data presentation:** publication of maps and scientific results in digital and paper forms
Main features:

Integration of geo-data from all sensing levels of the Earth
GIS-viewer and editor for digital mapping with support of the main vector and raster formats
Wide set of algorithms and rich tools for analytical processing:
- interpolation and extrapolation procedures
- structure, texture and morphological analysis of grids and images
- data quality analysis
- pattern recognition and zoning by a set of spatial characteristics
- 3D modelling
GIS INTEGRO
ORIGINAL MULTI-PURPOSE GEOINFORMATION SYSTEM

Combining the components of GIS INTEGRO under subjective user interface we develops software packages for different environmental researches:

• GIS FORECAST – for solution of the problems of mineral forecast

Automatisation of prognostic tasks for all stages of geological exploration of mineral resources:
• identification of perspective areas
• division of these areas by genetic types of minerals
• ranking by perspectiveness
GIS INTEGRO
ORIGINAL MULTI-PURPOSE GEOINFORMATION SYSTEM

Combining the components of GIS INTEGRO under subjective user interface we develops software packages for different environmental researches:

- **GIS GEOPHYSICS** – for processing and interpretation of geological and geophysical data

  Allowes for geological mapping, compilation of 2-D and 3-D models of geo-environment for understanding of Earth core structure, and identification of indicators for complex forecast of mineral deposits and petroleum fields
GIS INTEGRO
ORIGINAL MULTI-PURPOSE GEOINFORMATION SYSTEM

Combining the components of GIS INTEGRO under subjective user interface we develops software packages for different environmental researches:

• **GIS RESERVES EVALUATION GST** – for modelling and economic evaluation of deposit reserves

Support of reconstruction block solid-based models based on prospecting data using new approach to the problems of 3-D modelling, evaluation, and monitoring of reserves, mine design and economic tasks
GIS INTEGRO
ORIGINAL MULTI-PURPOSE GEOINFORMATION SYSTEM

Combining the components of GIS INTEGRO under subjective user interface we develops software packages for different environmental researches:

• **GIS GEOLOGY** – support of the digital geological mapping

*Tools for compilation and updating of geological maps with the use of generalization of fine-scale information*
IAS CONSTRUCTOR
TECHNOLOGICAL PLATFORM FOR IAS DEVELOPMENT

Technological platform for the rapid development of the information and analytical systems (IAS). It is a framework helping you quickly to create integrated distributed systems working with well-known database engines.

Key features:
• Complete visual approach to the client applications design without the need of the writing of the program code
• Common approach to the creating of the client desktop and web applications
• Advanced tools for the aggregation, processing and analysis of the heterogeneous data
• Open architecture for the integration between IAS Constructor and the third-party applications, extendable plug-ins support
• Spatial data built-in support and integration with the third-party geoinformation systems (GIS)
IAS CONSTRUCTOR
TECHNOLOGICAL PLATFORM FOR IAS DEVELOPMENT

The platform was successfully used for development of applied information and analytical systems in different fields of nature-use management, such as:

• monitoring of the groundwater state in Russian Federation and Republic of Kazakhstan
• monitoring of licensing of mineral deposits exploration and mining
• monitoring of oil and gas fields exploration and exploitation
MONITORING OF GROUNDWATERS
Information chapters of the database and catalogue of the groundwater deposits

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**Каталог паспортов месторождений подземных вод**

**Обозреватель**

- Государственный мониторинг подземных вод
- Государственный водный кадастр (ГВК)
- Месторождения ПВ
- Водозаборы
- Промышленные стоки
- Подземные сооружения
- Водобойные сооружения
- Водоснабжатели
- Водопотребители
- Контракты
- Разрешения на спец. водопользование
- Гидрогеологические и гидрологические структуры
MONITORING OF GROUNDWATERS
Visualization of the deposits on map in GIS (ArcView GIS, ESRI Inc.)
MONITORING OF GROUNDWATERS
Database information form for the deposit selected on the map
MONITORING OF GROUNDWATERS
Assessment of groundwater pollution using GIS-Integro interpolation procedures
MGS – MULTI-PURPOSE GEOINFORMATION SERVER

Tool for development of internet GIS-applications allowing for:

• catalogueing and quality presentation of the spatial data
• operative support of decision-making processes
• analytical processing of multi-level sensored information

MGS is being developed with the heavy emphasis on the international geospatial processing standards (ISO, OGC, CGI) and the free and open-source software.
MSG - available GIS tools

Session authorisation
MSG - available GIS tools

Interactive map structure and legend
MSG - available GIS tools

Navigation and magnifier windows
Spatial and attribute queries
MSG - available GIS tools

Zoom, pan, and scale
On-the-fly projection adjustment
Direct access to metadata
Built-in temporal controls
MSG - available GIS tools

Spatial measurements
MSG – SPATIAL GEOMODELLING SUBSYSTEM

Spatial geomodelling - prognosis of situation evolution based on complex assessment of the indigenous and outside factors identifying characteristics of an environment and impacts on it.

Foundation of the modelling process – integrated analysis of spatial characteristics of the model factors and calculation of a criterion function presenting current or future state of an object, area or process:
MSG – SPATIAL GEOMODELLING SUBSYSTEM

1. Building a model prototype
2. Filling a realization for the region under study
3. Calculation of the model nodes
MSG – SPATIAL GEOMODELLING SUBSYSTEM

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MSG – SPATIAL GEOMODELLING SUBSYSTEM

4. Analysis and interpretation of the results
MSG – SPATIAL GEOMODELLING SUBSYSTEM

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MSG – SPATIAL GEOMODELLING SUBSYSTEM

5. Re-calculation and forecast