Institute for Geothermal Researches DSC RAS,

Makhachkala, Daghestan, Russian Federation

Alkhasov A., Kaymarazov A., Kobzarenko D.

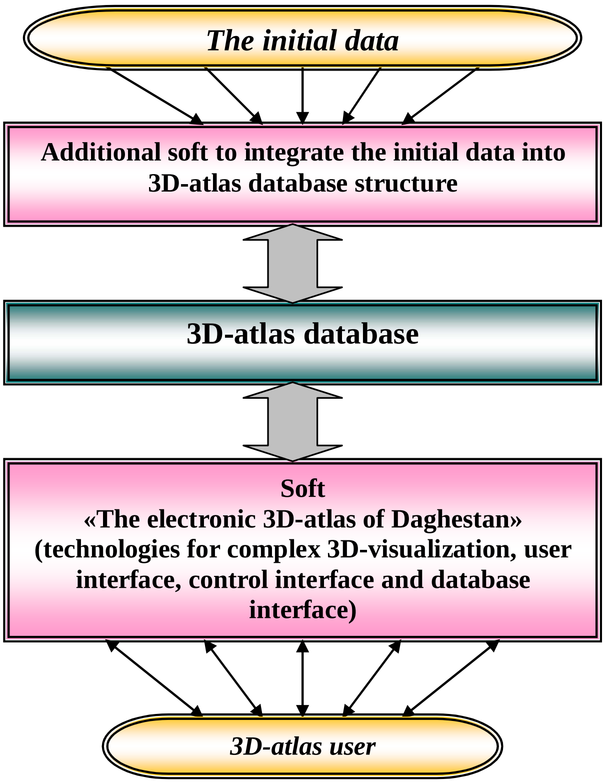
GEOINFORMATION TECHNOLOGIES IN GEOTHERMAL POWER OF DAGHESTAN

1. Project of the electronic 3D-atlas of Daghestan

Our project is directed to develop and to use 3D geoinformation technologies for:

- essential expanding of informatively and presentation of the visualized differ-thematic data;
- creating a flexible system having an opportunity to expand and to update the atlas by the new data;
- integration collected for long time data on the region in a single whole.

The project represents data structures and complex soft of GIS developed for scientific and practical purposes. It divides on two parts: development of the atlas data structure (object of visualization) binding to concrete region, and development of the atlas soft. The atlas data structure is set of the ordered spatial and attributive information on a visualization object. In our case this object is the Republic of Daghestan. The atlas soft is Windows application intended for import, configuration, management and visualization of the atlas data. The soft is not connected to the concrete visualization object. If it's necessary the application can operate with another object having the same structure.



The generalized diagram of 3D-atlas construction

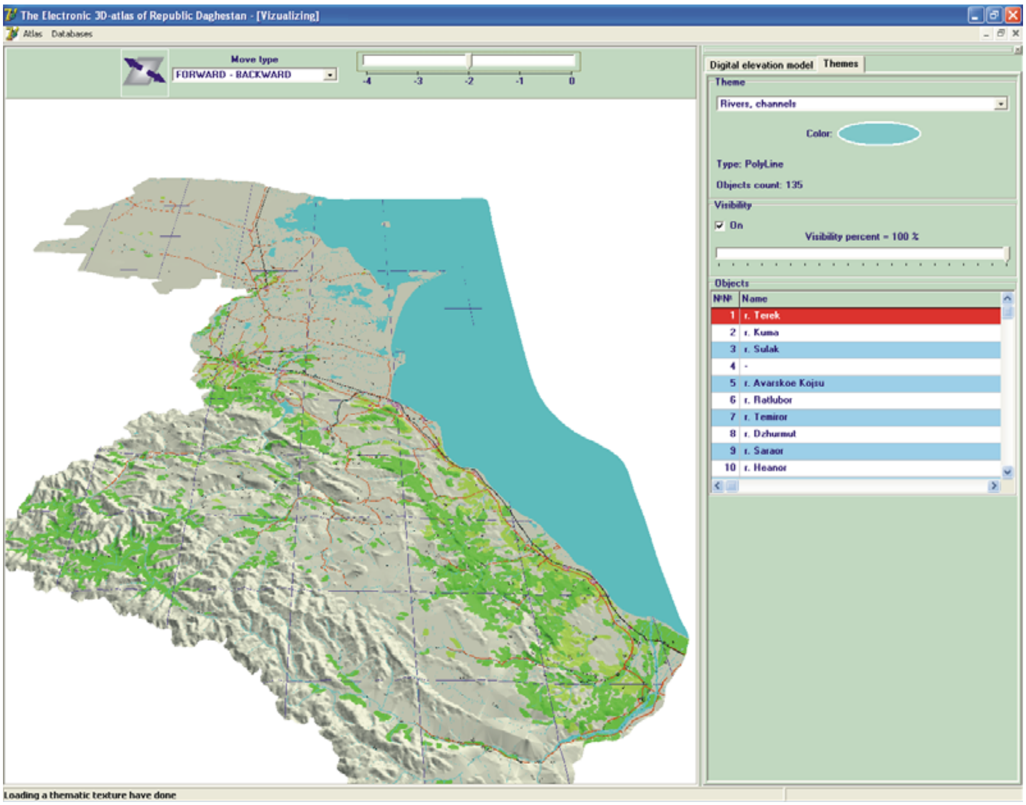
The atlas is packed from several components (blocks) of four types having its own data structure. For each block type it is created two program classes: the first one for management of its database (integration, editing the vector and attributive data), the second one for visualization (drawing by OpenGl and access to all attributes). Components of the atlas may be the following types:

1) ***Digital elevation model*** is stored on two ways: the first one - nodes array and triangular faces array, constructed on the basis of triangulation Delaunay, the second one - a regular grid. The first way is more convenient for fast visualization, the second way is more convenient for faster and more accurate calculation of the elevation value for any coordinates. The atlas may contain only one digital elevation model.

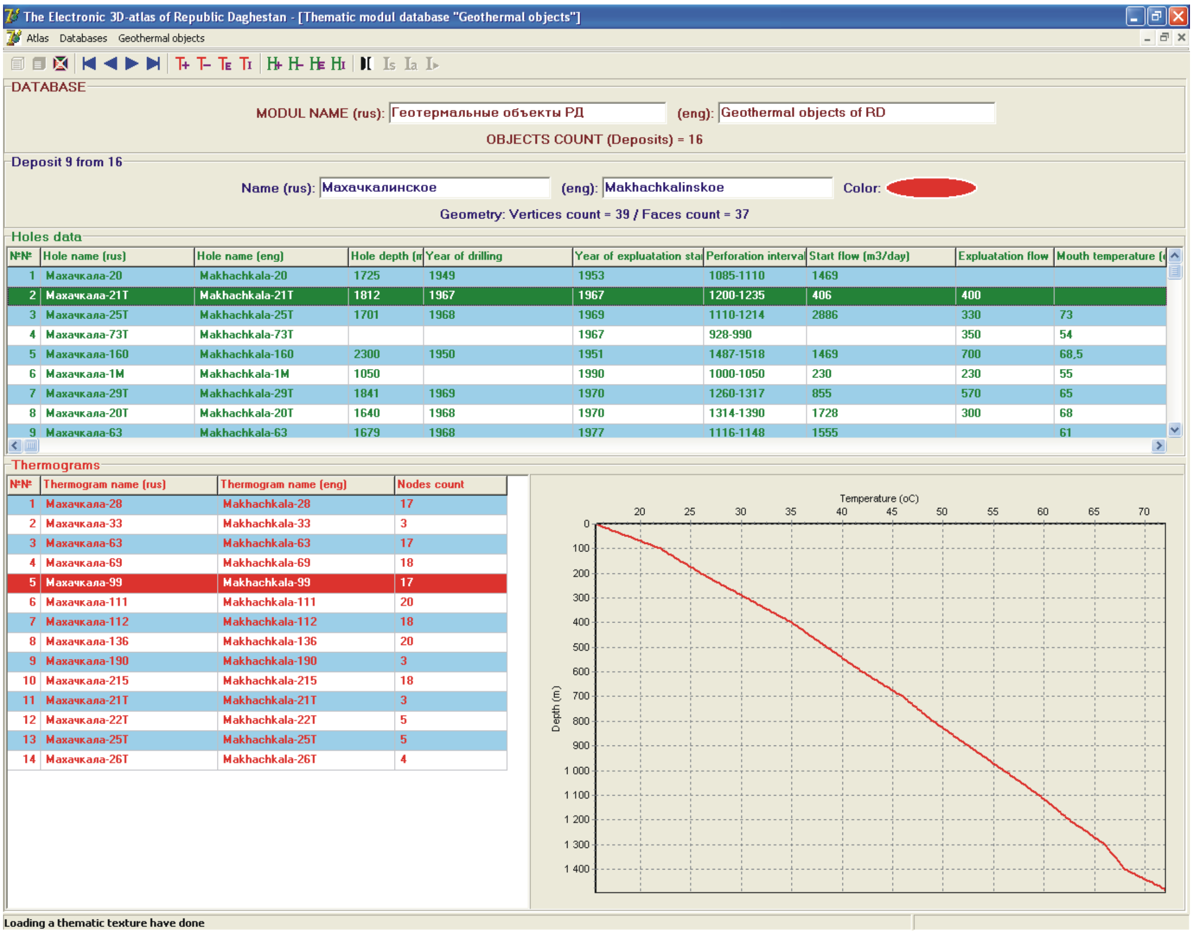
2) ***Thematic texture*** (to display on DEM) consists from name, data on pseudo-colors and matrix of color indexes, connecting to coordinates. The atlas may contain several textures and one of them is displayed on DEM.

3) ***Theme*** is an array of similar cartographical objects (to overlay on DEM), for example, rivers, railways, settlements. It is determined four types of themes: point theme, polyline theme, polygon theme and text theme. All objects (except text) are transformed into triangles to visualize. The atlas may display all accessible (loaded) themes.

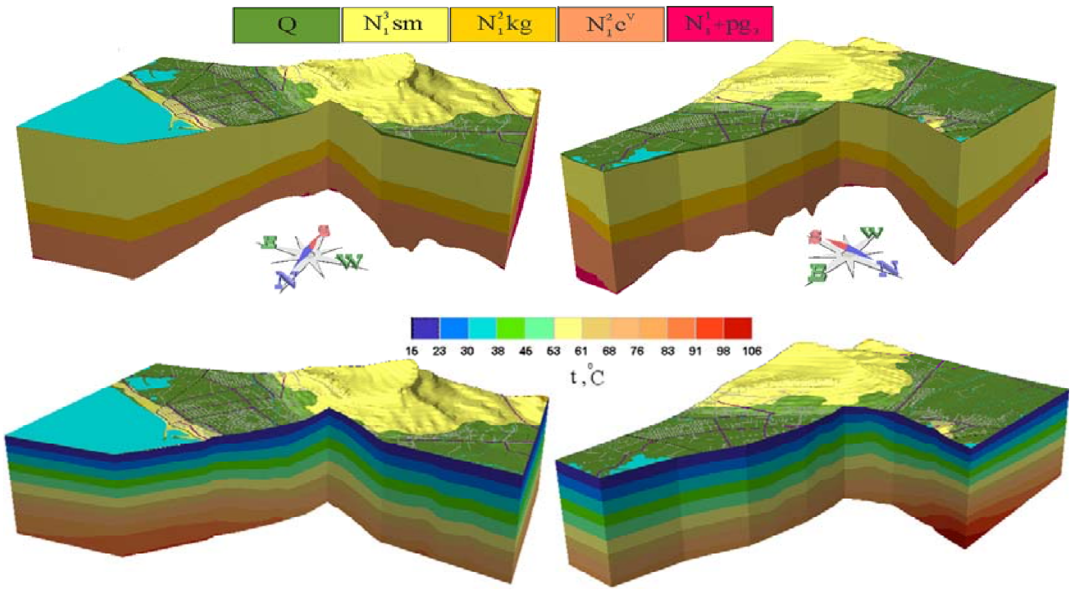
4) ***Thematic module*** is the most complex component of the atlas. It displays in 2D or 3D (if the third coordinate takes place) distribution of some structure, parameter or dataset concerned to some problem (task). For example, geological structure, distribution of deep temperatures, seismic events, etc. Depending on structure of the initial information, the data structure of thematic module and its visualization way is projected within the framework of the atlas.



Developing interface of the atlas



Developing interface of thematic module “Geothermal objects” database



Previous developments: Geologic structure and temperature field of Makhachkala city

<u>The project stage is active development</u>

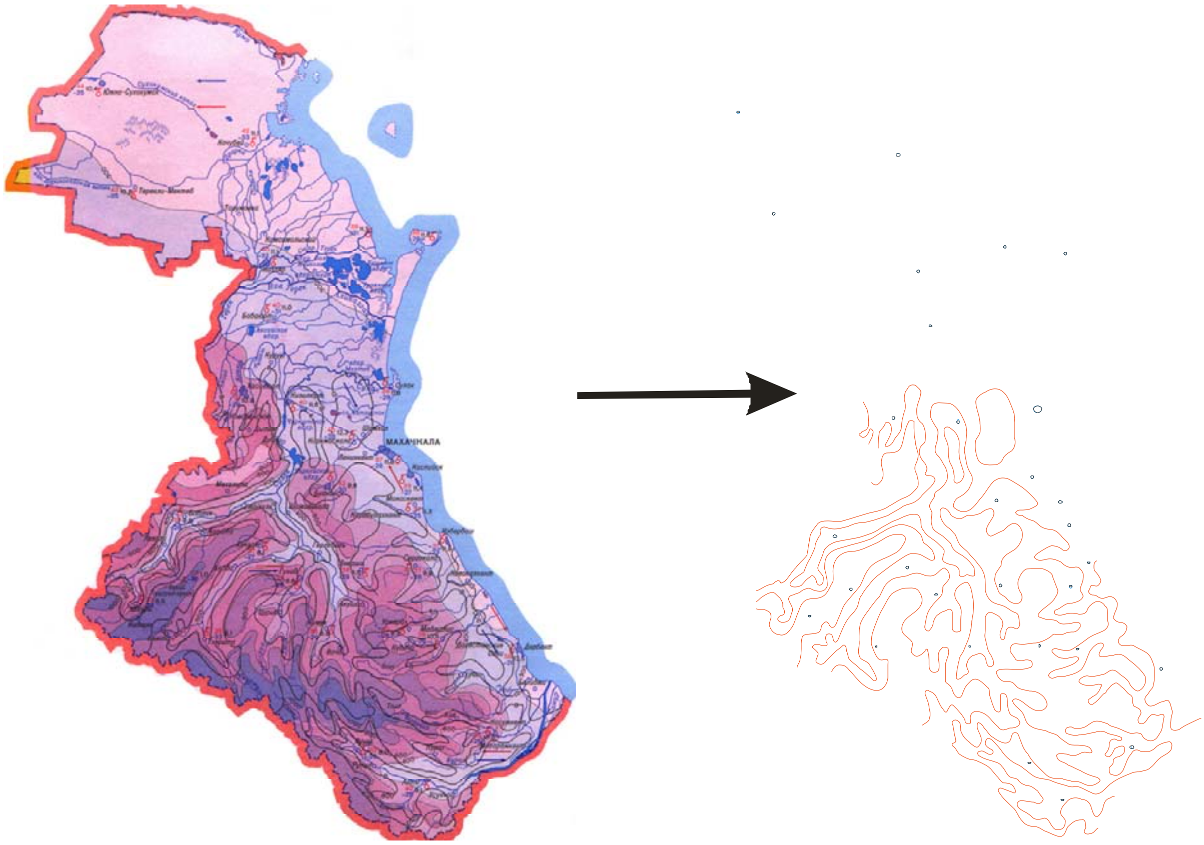
2. Automatic generation a map of the allocated value determined by functional dependence

Step 1. **Definition of functional dependence**

$Q = f\,(P_1, P_2, \ldots, P_n)$

Step 2. **Data gathering and their spatial positioning (vectorization)**

for each P_i to generate a dataset D_i : $[p_{i1}, x_1, y_1], [p_{i2}, x_2, y_2], \ldots ,[p_{im}, x_m, y_m]$



Step 3. **Transformation the data into a uniform projection**

for each dataset D_i to do:

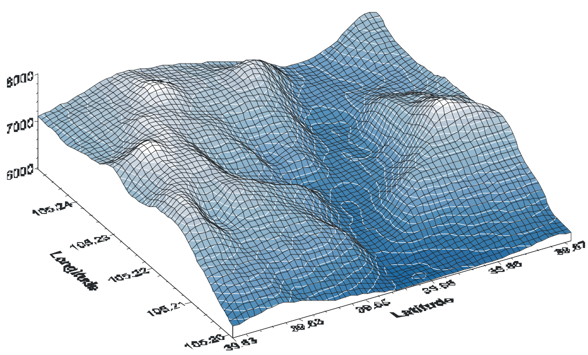
$[p_{i1}, x_1, y_1], [p_{i2}, x_2, y_2], \ldots ,[p_{im}, x_m, y_m]$

$\downarrow$ - transformation algorithm

$[p_{i1}, x_1^l, y_1^l], [p_{i2}, x_2^l, y_2^l], \ldots ,[p_{im}, x_m^1, y_m^1]$

Step 4. **Definition of parameters for a regular grid**

Xmin, Ymin, Xmax, Ymax, Space

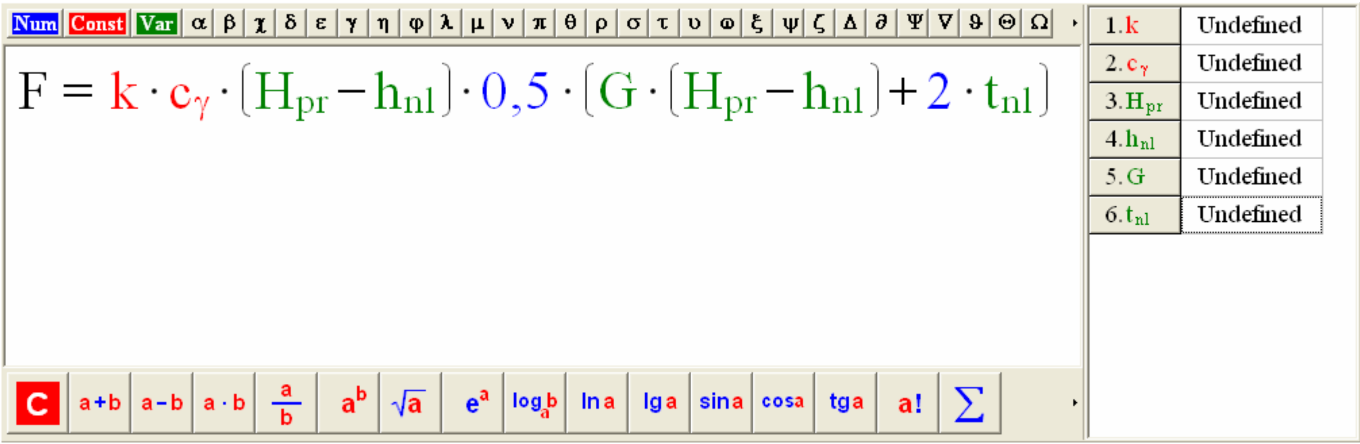


Step 5. **2D interpolation of the data**

for each dataset D_i to generate a regular grid RG_i

Step 6. **Entering the formula**

Special component to enter the formula:



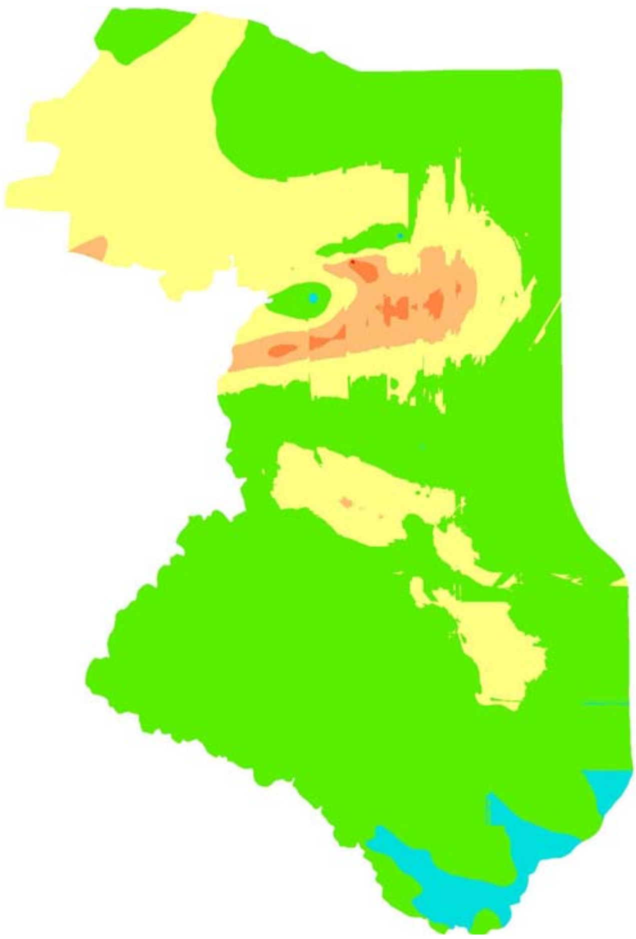
Step 7. **Calculating the result regular grid**

Each node of the result regular grid are calculated by the entered formula and corresponded nodes from grids GR_i

Step 8. **Definition of pseudo-colors for values**

The value range is divided into parts and a color for each part is specified

Step 9. **Generation the raster image of the allocated value**

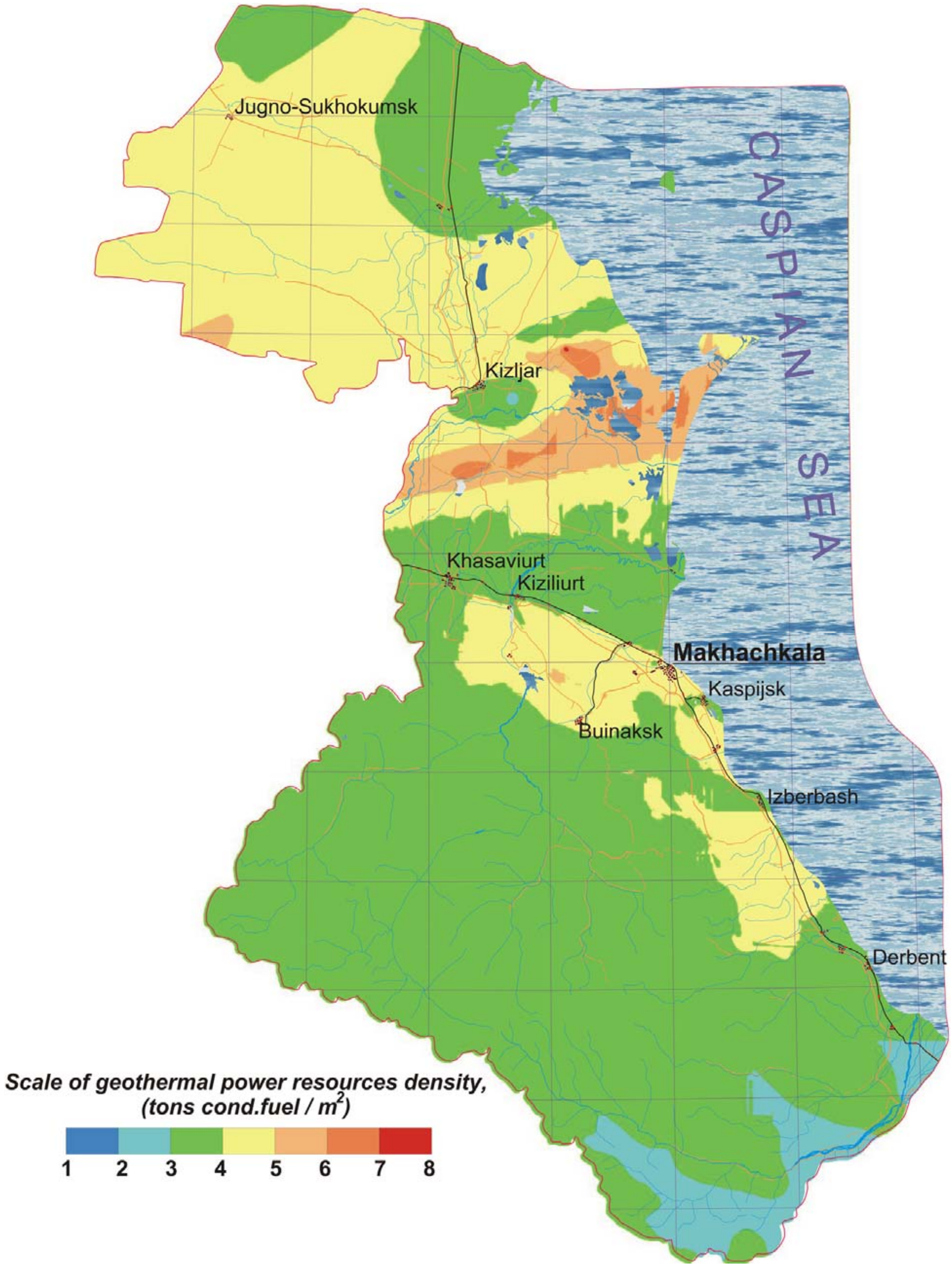


Step 10. Overlaying map objects and addition a legend

Potential geothermal resources of Daghestan (prediction depth 5km)

Calculated by methodic of E.I.Boguslavsky

(St.Petersburg State Institute of Mines)



Technology for automatic generation a map of the allocated value is during active development of soft