RUSSIAN ACADEMY OF SCIENCES
INSTITUTE FOR INFORMATION TRANSMISSION PROBLEMS
(KHARKEVICH INSTITUTE)

GeoTime 3

USER GUIDE

Version 3.0, 10.12.2016

Moscow

Summary

The network GIS GeoTime 3.0 is intended for an interactive presentation, analysis and modeling of vector and grid-based geographic information on spatio-temporal processes with local interaction. The system is realized as Java-application. To launch GIS GeoTime 3.0 it is necessary that a virtual Java machine (the version not less than 1.6) has been installed on the user's PC. GIS loading occurs under Java Web Start technology

Project leader: Prof. Valeri Gitis,
Chief programmer: Ph.D Alexander Derendyaev
Institute for Information Transmission Problems RAS
(Kharkevich institute),
Section of Geoinformation Technologies and Systems
B. Karetnyi Lane 19, 127994 Moscow, GSP-4, Russia,
Phone:+7-495-6995096, Fax: +7-495-6500579,
e-mail: gitis@iitp.ru

CONTENTS

1. General information

Dynamic GIS GeoTime 3 is realized as Java-application. To launch GIS it is necessary that a virtual Java machine (the version 1.6 or more) has been installed on the user's PC. GIS loading is performed under Java Web Start technology. Application of Java Web Start technology allows to use important positive aspects of Java Applet technology (first of all, it is convinient to disseminate the actual version of the application via Internet) as well as the advantage of running the system without web browser. The latter property allows to stave off negative influence of web browser: in particular, to eliminate the additional restrictions on the amount of memory available for Java application. This is a crucial factor taking into account the significant volume of geographic data with which GIS GeoTime 3.0 works.

The version supports the operations with geographic data given in degree coordinates. The modules of GIS GeoTime are implemented in plug-in technology. This architecture allows flexibly changing GIS functionality.

GIS GeoTime 3 and demo GIS-projects are available at http://www.geo.iitp.ru/GT3/ .

GIS GeoTime 3 system performance.

Software architecture and file operations

- Java-application, loaded via Java Web Start technology.
- Plug-in architecture, which provides flexible adjustment to the subject domain.
- Multithreaded data loading and parallel computing.
- Dynamic loading of data and plug-ins from remote servers and users' PC.
- GIS startup with user's data.
- Saving GIS-project and data on the user's PC.
- GIS interface for launching computations on remote servers and in GRID.
- Auto-complete the transaction log.

Analytic functions

***Visual analysis*:**

- Interactive data presentation in the form of maps, charts, sections, profiles and tables.
- Animated visualization of one or more spatio-temporal processes represented by scalar and vector grid-based fields, points, lines, and polygons.
- Cartographic input of markers: points, polygons, circles and ellipses.
- Tabular and graphic representation of the vector layer attributes.
- Cartographic measurement of distances, areas, values of the grid fields, attributes, sections, profiles, and time series.
- Calculation of the scalar grid based field statistics for user-defined zones.

***Analytical modeling*:**

- Analysis of the local properties of processes with the methods of grid based filtration.
- Aggregation of the properties of processes with the field statistics in time and depth.
- Hierarchical cluster analysis of time series fields.
- Comprehensive analysis of the properties of processes with grid computing.
- Calculation of scalar grid based fields of spatial and spatio-temporal properties of point and line objects.
- Analysis of geographical objects by means of calculation of new attributes.
- Detection and analysis of the areas with similar dynamics.
- Universalization of analysis by data converting.

***Analysis of seismological processes*:**

- Selection of a seismic flow cluster component.
- Calculating the scalar grid based fields of minimum representative magnitudes, seismic activity, b-value, and RTL.
- Detection of anomalies in spatio-temporal fields.
- Estimating the parameters of the anomalies.

Comments:

- The active layer may not be a map layer .
- Content of the window «Properties» depends on the type of the active layer.
- Operations of visualization in the window «Properties», as a rule, are initialized with the button «  », which appears when you click LMB on the right side panel of the operation. If the button does not appear, it is necessary to click LMB in the title bar of the list of transactions and then to click again on the right side of the toolbar.
- If the parameters of operations are keyboarded in dialog boxes, then the end of keyboarding of a parameter is either inputing the next parameter or pressing the «Enter» key.
- A decimal point in a dialog window can be entered either as a dot "." or as a comma ",". To ensure the correct symbol is entered, check the window after you clicked the «Enter key».

1.1. Data types

GIS GeoTime 3.0 supports the operations with 2D, 3D and 4D vector and grid-based data, WMS and tile cartographic images.

Dynamic geographic world is represented by continuous and discrete entities, properties and relationships in coordinates X, Y, Z, T, where X and Y are the geographic coordinates (longitude and latitude, respectively), Z is the height (or depth), T is the time.

Continuous entities are scalar or vector functions on regular 2D, 3D and 4D grids. *Scalar 2D fields* are the following functions: $f(x,y)$, $f(x,z)$, $f(x,t)$, $f(y,z)$, $f(y,t)$, $f(z,t)$; *3D fields* are the functions $f(x,y,z)$, $f(x,y,t)$, $f(x,z,t)$, $f(y,z,t)$, *4D field* is the function $f(x,y,z,t)$.

Vector 2D and 3D fields are planar vector functions with components directed along the axes of geographical coordinates: $\mathbf{s} = s_x(x,y)\mathbf{x} + s_y(x,y)\mathbf{y}$, $\mathbf{v} = v_x(x,y,z)\mathbf{x} + v_y(x,y,z)\mathbf{y}$, $\mathbf{u} = u_x(x,y,t)\mathbf{x} + u_y(x,y,t)\mathbf{y}$.

Discrete entities are geographic objects, such as lines, polygons and points. Attributes of the objects can be numbers, vectors or strings. Coordinates and attributes of the objects may vary both in time and space**.**

Lines and polygons can be represented either in geographical coordinates X, Y or in space-time coordinates X, Y, T.

The points can represent geographic objects in coordinates X, Y or numerical series in coordinates X, Y, T or X, Y, Z, or fields of events in the coordinates X, Y, Z, T.

A special type of point data are geographically localized temporal sequences. Time series are always refered to fixed points. Time series can be one or two dimensional.

In addition, *raster* map images in WMS format (Web Map Server, the format OGC) and the tile maps (for example, OSM, Kosmosnimki, etc.) are coming from remote servers and used as a background framework.

Homogeneous and semantically uniform data is pooled into information layers. XML-files are used to describe the layer's metadata. Usually (but not necessarily) information layers related to a problem are combined into a GIS project. The project is a set of information layers on a spatial or spatio-temporal region. It is convenient to save each project in a separate directory as a set of data files and metadata. GIS project metadata is contained in a configuration XML-file.

1.2. External formats

In order to exchange data with other GIS, the data layers of GIS GeoTime 3.0 use the following formats: SHP, CSV (somma-separated values), GRID (ESRI), WMS, and ASCII.

SHP is an external format for vector data (points, lines and polygons).

For scalar grid-based fields, catalogues of events and time series ASCII formats can be used. To input 2D and 3D vector fields, two scalar grid-based fields of X and Y components should be input. After that, GeoTime 3 converts the scalar grid-based fields into the grid-based vector fields.

ASCII format of grid based scalar fields

Format FLT is a text format of 2D, 3D and 4D scalar grid-based fields. This format is the analog of GRID (ESRI) format.

An FLT file consists of three parts.

The *title* is a line containing 8 parameters of the geometry of grid data which are separated by spaces:

<COL> <ROW> <Xbeg> <Ybeg> <Dx> <Dy> <Intr> <Geog>

COL - number of columns in the grid.
ROW - number of rows In the grid.
Xbeg - coordinate of the left column of the grid (longitude in degrees).
Ybeg - coordinate of the top row of the grid (latitude in degrees).
Dx - distance between adjacent columns of the grid (along longitude in degrees).
Dy - distance between adjacent rows of the grid (along latitude in degrees).
Intr - 1 or 0 – it is not used in this version.
Geog - 1 or 0 – it is not used in this version.

The *data* consists of numbers separated by space or carriage return. The first number corresponds to the grid point with coordinates Xbeg, Ybeg, it is followed by numbers corresponding to the coordinates (Xbeg +1, Ybeg), (Xbeg +2, Ybeg), ... (Xbeg + COL, Ybeg), (Xbeg +1, Ybeg + 1), (Xbeg +2, Ybeg +1), etc. The total number of elements is equal to COL * ROW.

The unknown values are denoted by a point symbol, «.».

2D grid layer in FLT format is represented by two files: a text configuration file with a reference to the filename and an FLT file with 2D grid based layer (in X and Y coordinatets).

The configuration file consists of two lines: the first line can contain any text; the second line contains the filename of the FLT file with 2D grid layer. An FLT file with 2D grid layer is always saved in a subdirectory named «DATA». Below is an example of such a file:

```
1 2 3 4
EuroTopo30.flt
```

3D grid layer in FLT format is represented by the following files: a configuration text file with links to all 2D slices of the 3D layer and by FLT files corresponding to each of the 2D slices of the 3D layer (in coordinates X, Y). The former file consists of N +1 lines: the first line can contain any text, the following lines give a list of the filenames in the order that corresponds to the order of slices of the 3D grid based layer. The slices of the 3D grid layer are always saved in a subdirectory named «DATA». Below is a sample file with links to all slices of a 3D layer:

1 2 3 4
TOMO-0_M.flt
TOMO10_M.flt
……..
TOMO190_.flt
TOM200_M.flt

4D grid layer in FLT format is represented by a configuration text file with links to all 2D slices of the 4D layer and by FLT files each containig a 2D slice of the 4D grid layer (in coordinates X, Y). The first line of the configuration file may contain any text. In the following lines a matrix of the filenames of all 2D slices of the 4D grid layer is presented. Denote by M the number of columns and by N the number of rows of this matrix (each row of the matrix corresponds to a fixed third coordinate of the 4D grid layer while a column – to the fourth one). Thus the nm-element of the matrix (n = 1, ... , N, m = 1, ..., M) is the name of the 2D slice corresponding to the 3-rd coordinate being equal to n and the 4-th coordinate being equal to mInterpretation of the 3-rd and the 4-th coordinates (either time or height) should be determined by the user during the data input. Thus, the order of the file names is the order of the matrix elements:

11 … 1m … 1M
…
n1 … nm … nM
…
N1 … Nm … NM

Files of the slices of 4D grid layer in FLT format are always saved in a subdirectory named «DATA».

An example #1 of a filename matrix:

2001_0.flt 2001_1.flt 2001_2.flt 2001_3.flt 2001_4.flt 2001_5.flt
2002_0.flt 2002_1.flt 2002_2.flt 2002_3.flt 2002_4.flt 2002_5.flt
2003_0.flt 2003_1.flt 2003_2.flt 2003_3.flt 2003_4.flt 2003_5.flt

Here, the third axis is T (time) from 2001 to 2003, and the fourth axis is Z (depth) from 0 to 5.

An example #2 of a filename matrix:

0_Jan.flt 0_Apr.flt 0_Jul.flt 0_Oct.flt
5_Jan.flt 5_Apr.flt 5_Jul.flt 5_Oct.flt
10_Jan.flt 10_Apr.flt 10_Jul.flt 10_Oct.flt

Here, the third axis is Z (depth) from 0 to 10, and the fourth axis is T (time) from Jan to Jul.

ASCII format of the catalogue of events

Catalogue of the earthquakes can be represented in the form of a text table. Delimiters are spaces. Each row of the table refers to a single event (earthquake). The last row of the table must be empty.

Below is an example of earthquake catalog in text format:

Year MM DD Long Lat Class HH Min Sec
1980 1 1 76.450 42.950 7.0 0 30 14.0
1980 1 1 74.010 42.350 6.3 23 7 43.0
1980 1 2 72.760 42.050 7.3 1 31 5.0
1980 1 2 78.200 43.180 7.2 20 11 18.0
1980 1 2 73.900 40.680 7.1 20 24 31.0
1980 1 3 73.450 40.580 8.6 9 30 48.0
1980 1 3 74.980 40.880 9.2 11 22 10.0

ASCII format of series

Each layer must be saved in a separate directory. The directory name is arbitrary <any NAME>. Each series represents the values of some characteristics (changing with time or depth) at a single space point and is saved in a separate file. The first line of the file contains the coordinates X (longitude), Y (latitude) of the point and any text attribute information, such as point number, the name of the monitoring station etc. Each of the following rows represents the value of the time series in the format: year, month, day, hour, minute, second, the value of the characteristics. For example:

<Longitude> <latitude> number-of-station name-of-station etc
yyyy mm dd hh mm ssss VALUE
yyyy mm dd hh mm ssss VALUE
yyyy mm dd hh mm ssss VALUE
yyyy mm dd hh mm ssss VALUE
yyyy mm dd hh mm ssss VALUE
yyyy mm dd hh mm ssss VALUE
……..
yyyy mm dd hh mm ssss VALUE

2. Operations

2.1. Launch window

The address of GIS-project window is http://www.geo.iitp.ru/GT3/. The menu of the launch window is shown in Fig. 1.

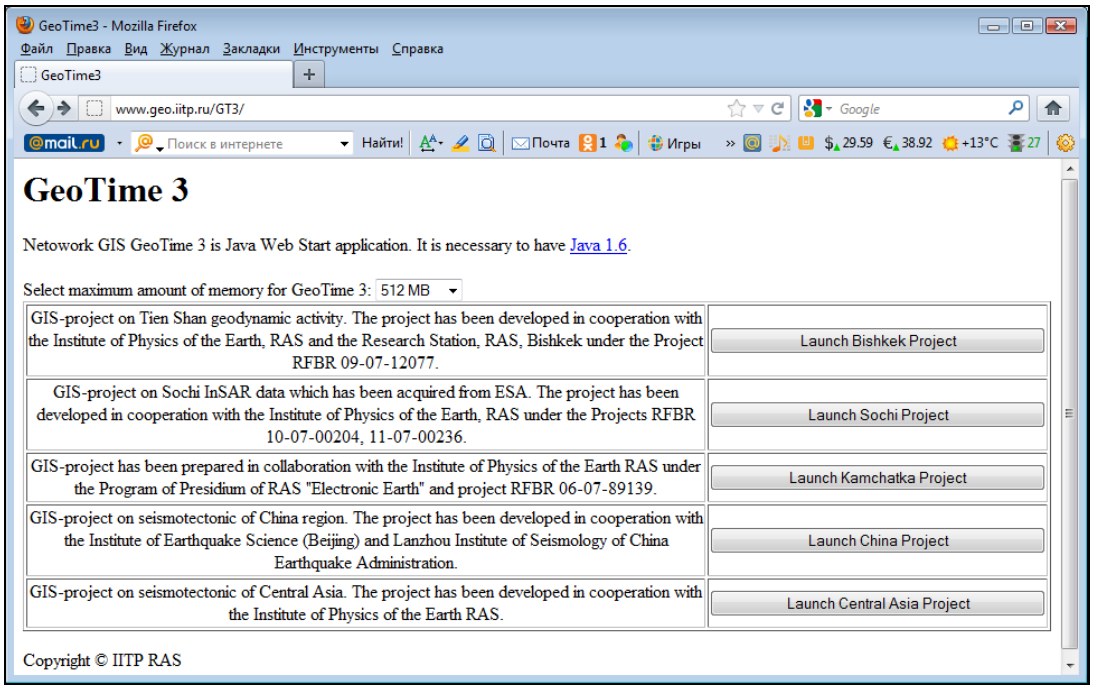


Fig. 1.

First of all a user ought to select the maximum amount of memory (from 512Mb till 2000Mb is possible) using the panel «Select maximum amount of memory for GeoTime 3». After that a user loads GIS-project and GIS using the panel «Launch <name of the GIS project>».

Remark. The usage of tile maps such as «OSM, "Kosmosnimki official» is allowed. Permission to use the other tile maps has not yet been received.

2.2. GIS-project window

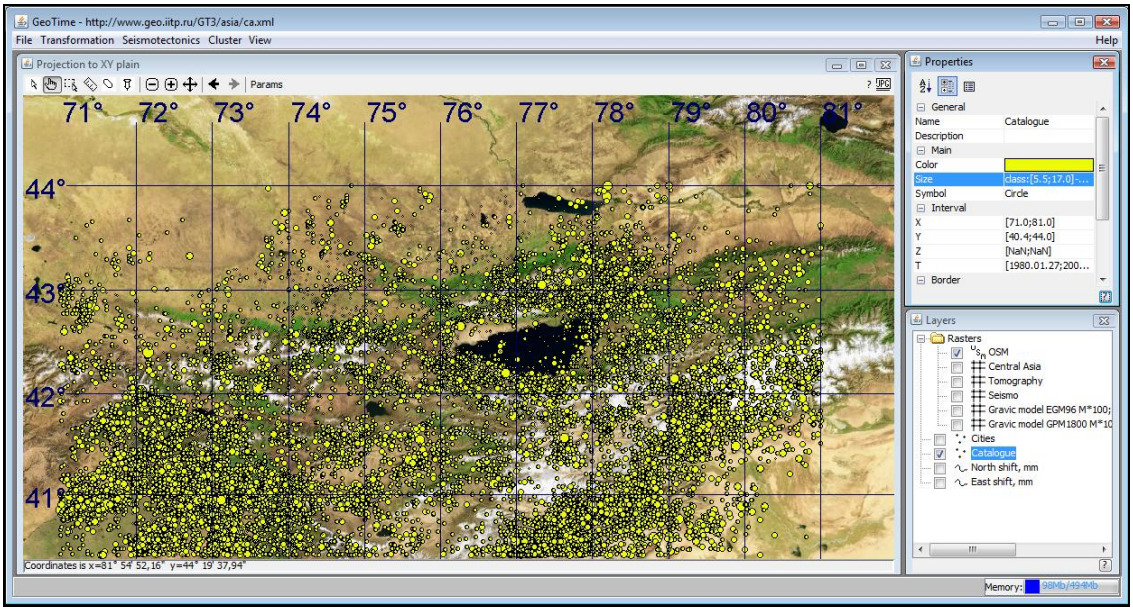


Fig. 2.

GIS-project window contains *the map window* (in the center), *the window of the geo informational layers* («Layers»), *the window of the layer attributes* («Properties»), *the visual control panel* («Projection to XY plane», the panel at the top), *the control panel of the operations* (the upper panel). Below on the right is the "Memory" indicator, where the first number is the amount of used memory and the second one is the amount of the allowed memory. The user can change the location and size of the windows as well as the control panels. Context help is invoked by pressing the left mouse button (LMB) on the button «?».

*The map window*s are available for all two-dimensional projections: XY, XZ, XT, YZ, YT, ZT (see, e.g., Fig. 3).

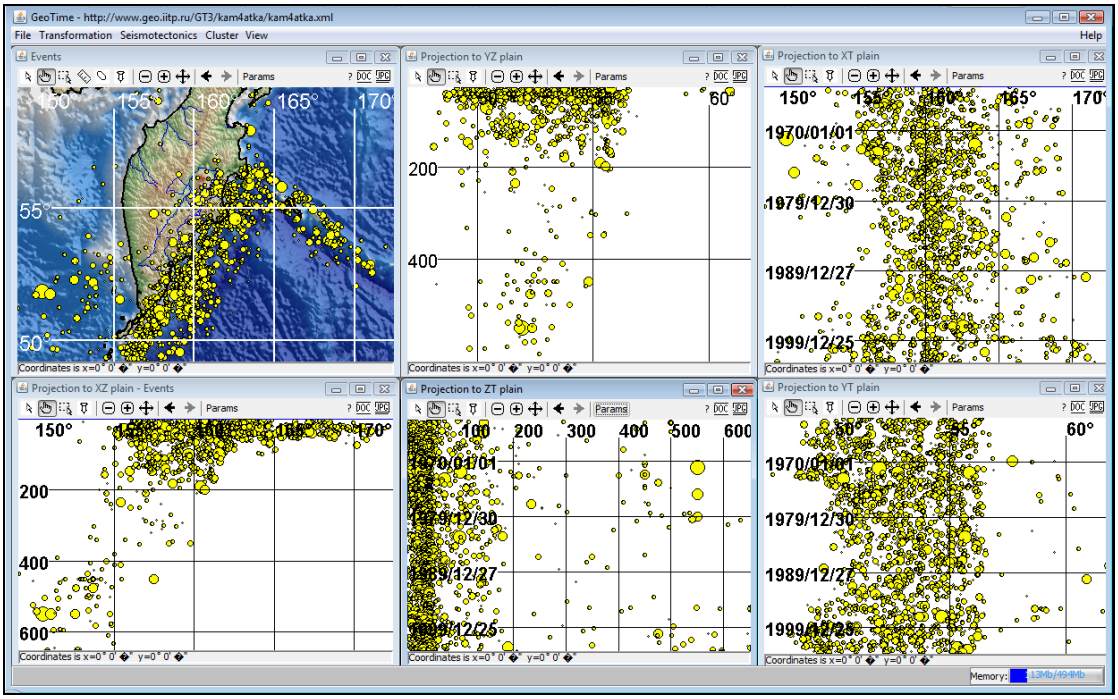
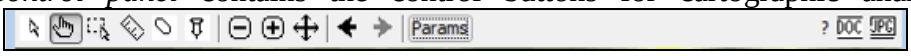


Fig. 3.

The user can change the window disposition and size. It is necessary to remember that pressing Alt+F4 closes the basic window.

2.3. Map window and the visual control panel

Changing the scale of a map fragment and *resizing the map window* are performed in standard Windows. Changing the scale and size will automatically change the step of the grid.

The visual control panel contains the control buttons for cartographic analysis and measurements 

(see also Section 2.4).

 - select a point at the map, measure its coordinates and the attribute of the nearest to the point vector object, or the value of the 2D grid layer at the point, or the value of the 2D slice of the 3D grid layer (corresponding to a fixed time value) at the selected point.

 - move a map within the map window.

 - select and display a rectangular area of the map.

 - build and measure the length of the polyline.

 - build a polygon and measure its area (a polygon is a domain with a piecewise linear border without self-intersections).

 - put a label on the map.

 - zoom out.

 - zoom in.

 - show the whole map.

 - "Undo" the action a step backward.

 - "Undo" the action a step forward.

- select projection and set degree grid.

 - context help

 - save the history of the analysis in the «docx» file format.

 - save the images of the map window in JPG format.

Operations «*Slice of Layer*» and «*Focus on layer*» are launched with the buttons  ,  ,  ,  if you click RMB in the map window (Fig. 4)

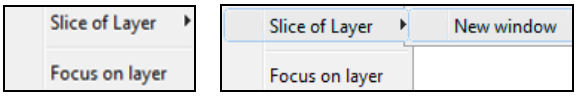


Fig. 4

- «*Focus on layer*» - change the map scale to fit the map of the active layer.
- «Slice of Layer» - display the values of the active 2D or 3D layer at a point specified by cursor.

Let 2D grid layer be activated. When you click LMB on «Slice of Layer» the window «New window» appears (Fig. 4, on the right). After pressing the LMB the box «Slice #» appears. It displays the coordinates of the layer in degrees and the value of the layer (Fig. 5). If you click in

the box «Slice #» RMB, then a box of control measurements appears (Fig. 5, on the right). The menu of the operations in the box uses the language of Windows installed on the user's PC. Operation «Follow» allows you to interactively measure the values of the active layer at any point under the cursor XY. The output of the operation is performed by LMB.

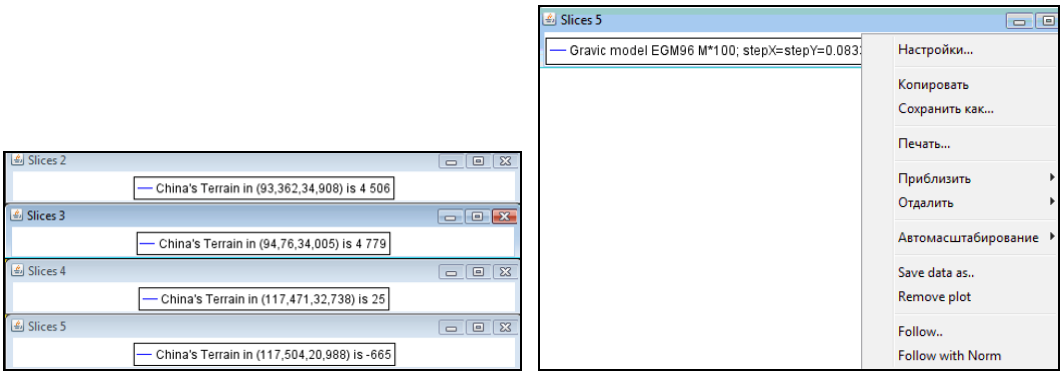


Fig. 5.

Let a grid 3D layer be active. When you click LMB on the tab «Slice of Layer» (see Fig. 6) the box «New window» appears. After clicking the LMB on the tab «New window», the box «Slice #» appears and in a new window appears the chart, which shows the dependence of the values of the 3D layer on time or depth (Figure 7). Under the chart are the coordinates of the point selected by cursor.

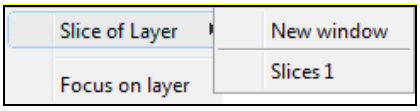


Fig. 6.

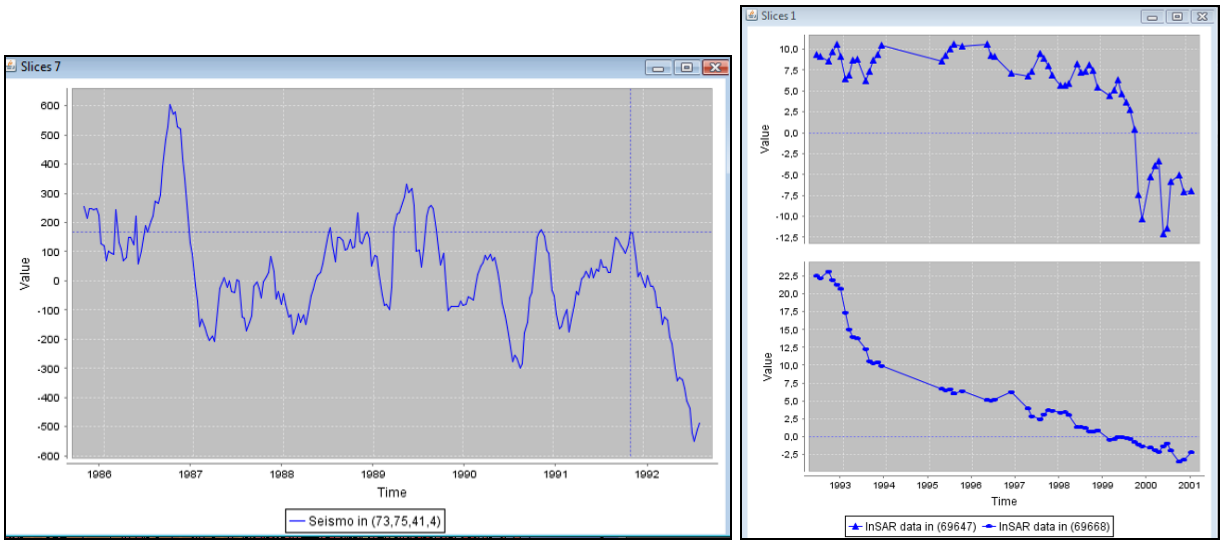


Fig. 7.

If the active layer is the earthquake layer, after clicking LMB on the tab «New window» a window like in Fig. 8 appears (for 3D and 4D layer). In the window you have to specify the radius of the circle in km, and the sequence of points within the given circle will be displayed on the chart. In Fig. 8 the radius of 10 km is selected.

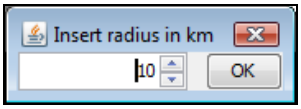


Fig. 8.

A combination of several charts corresponding to the time series, 3D scalar field and the earthquake catalogue is shown in Fig. 9. After pressing the RMB in the window «Slices», the window control charts appears (Fig. 9, on the right).

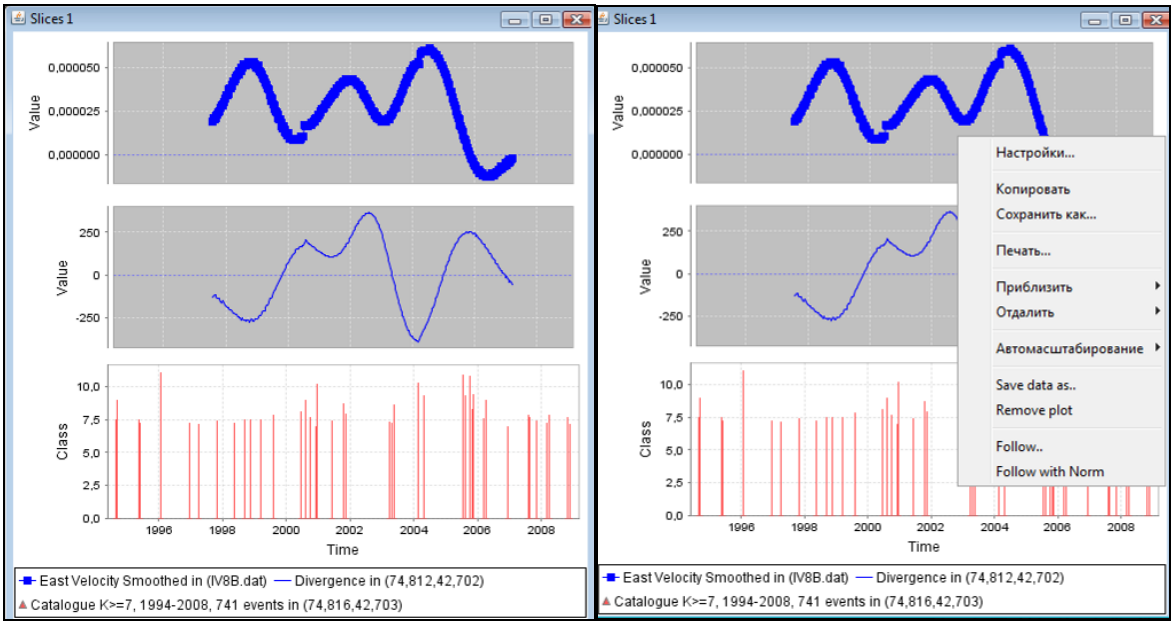


Fig. 9.

Let us consider as an example the functions «Follow» and «Follow with Norm». Click LMB on the tab «Follow». After that, all the charts will correspond to the cursor position in the map window (Fig. 10). To stop the process of measuring, you should click the LMB in the map window.

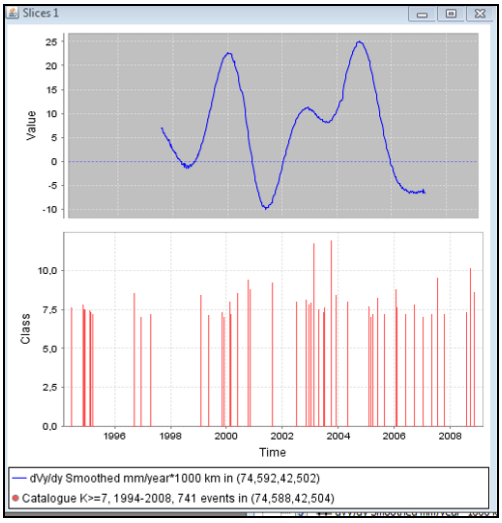


Fig. 10

The mode «Follow with norm» differes from the mode «Follow» only by the scale: the scale of the 3D layer corresponds to the maximum value of the field.

The measurement of distances. To run the operations of the distance measurement, it is necessary to click the icon «  ». Next, set the cursor to the desired point (for example, along the lines) and press LMB. Each time you press LMB the line segment is added. Near the end point the value of the distance along the whole line in km is shown. You can change the shape of the line. To do this, put the cursor to any point of the line, press the LMB and drag the point to the desired location. The Operation "Clean Line" is described below.

Operations «Section» and «Clear line». Operation «*Section*» is performed only with the 2D grid field. At the first stage, a profile (a line) is entered. Then, the section is calculated. Consider an example. Let a 2D grid layer be active. Build a profile. Click in the map window with the RMB. A window like in Fig. 11 appears.

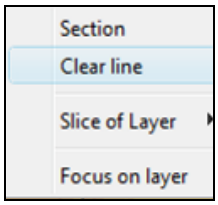


Fig. 11

Click «Section». The window like in Fig. 12 opens. Select the needed 2D layer in the pulldown list of layers.

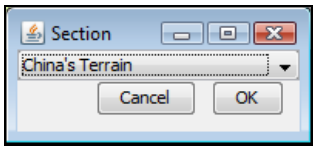


Fig.12

Click «OK» button. A window appears with the chart of the section (Fig. 13). The red dots on the graph correspond to the profile jogs. The white dot on the profile corresponds to the cursor position on the chart. To measure the values on the graph, it is necessary to click LMB at the corresponding points of the chart.

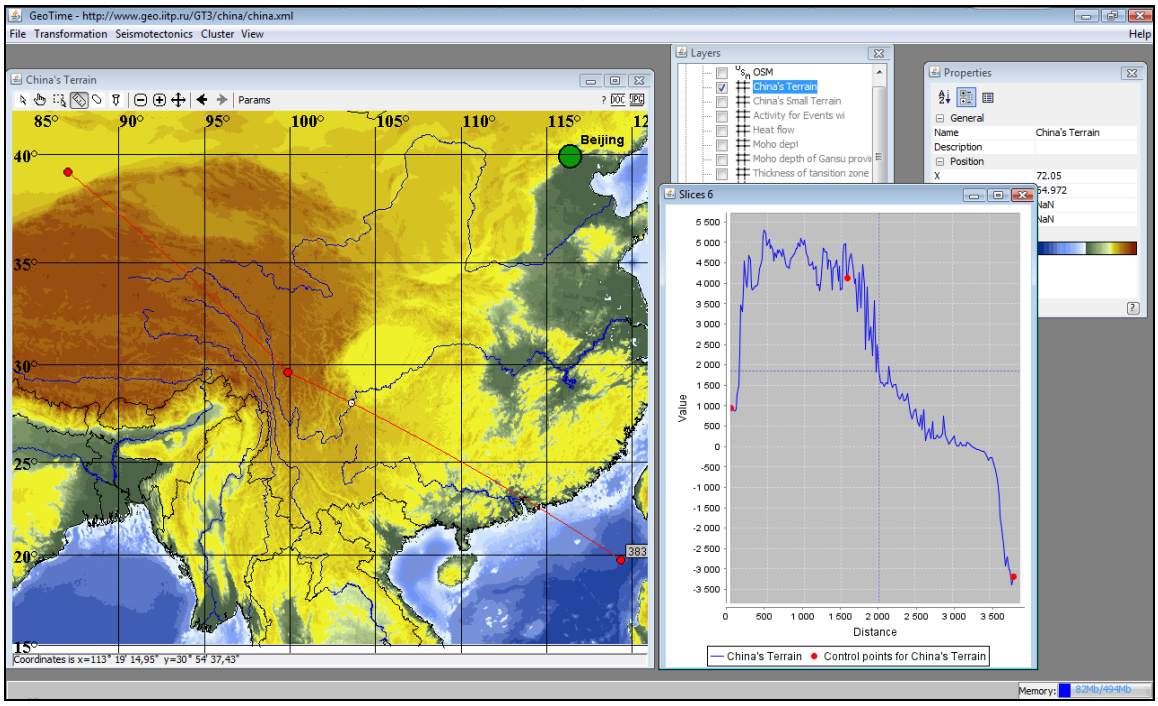


Fig. 13.

Like a line, you can interactively change the profile. A chart of the section will be changed automatically. To access the chart management window you have to click RMB in chart window (Fig. 14).

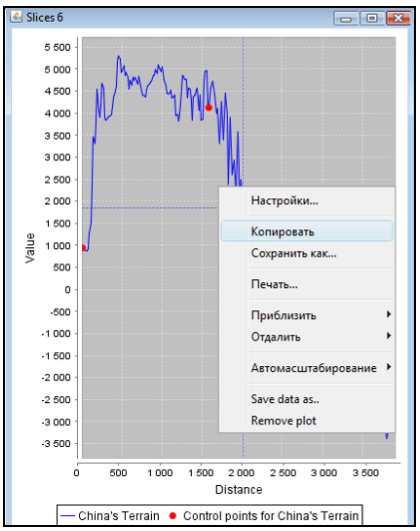


Fig. 14.

To remove the profile, it is necessary to click LMB on the tab «*Clear line*».

Construct the polygon and measure its area. To start operations should click the icon «  ». Next, set the cursor at the desired points of the map and click LMB. Near the last point of the polygon (without self-intersections) the value of its area in km^2 displays. You can change the shape of the polygon. To do this, put the cursor at, press LMB and drag the desired location jf the map.

Operation «Get statistics» and «Clear polygon». The operation «Get statistics» is performed only with the grid of 2D and 3D fields. At the first stage the polygon is cosntucted. Next you need to click RMB in the map window. A window (Fig. 14) appears. Click the tab «Get statistics». The window «Statistics», Fig. 16, opens. Select the type of statistics, «Mean», «Max» or «Min», and the name of the 2D or 3D grid layer in the pulldown.

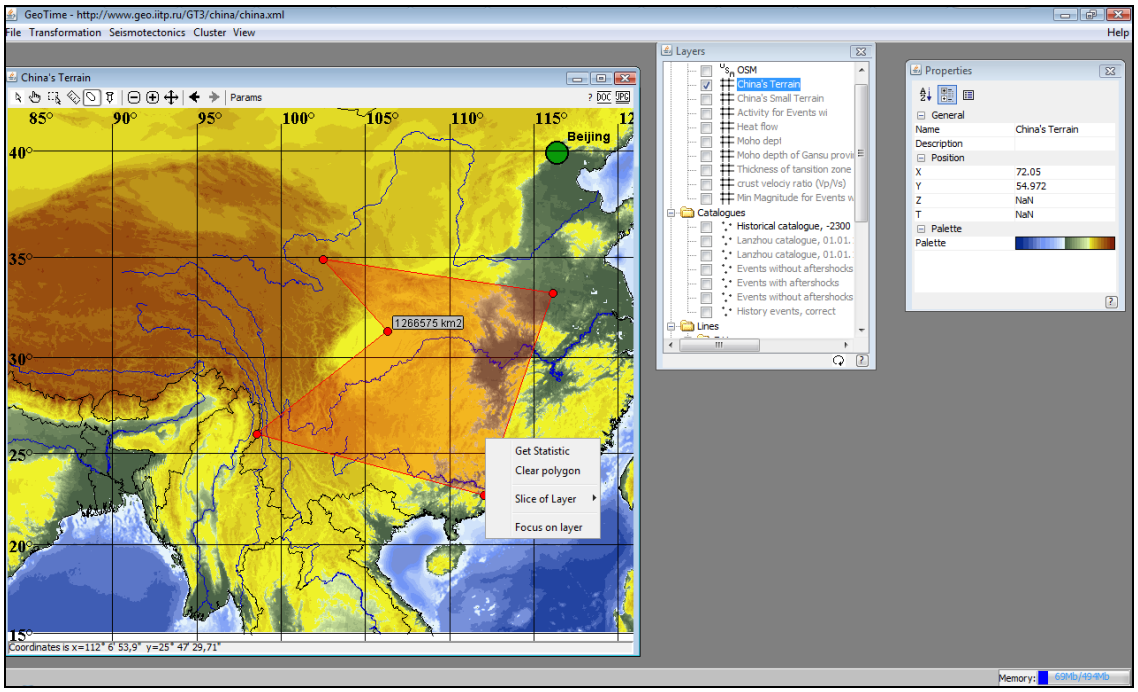


Fig. 15.

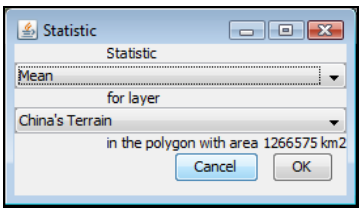


Fig.16.

Click «OK» button. If 2D grid layer is selected, then the window «slice #», Figure 17 indicated the selected statistics. Recall the window, Fig. 15, allows to calculate other statistics for the same layer. In this case the result can be written in the same window or open a new window. Fig. 17. shows three statistical test site in one window, near the window is shown with statistics management..

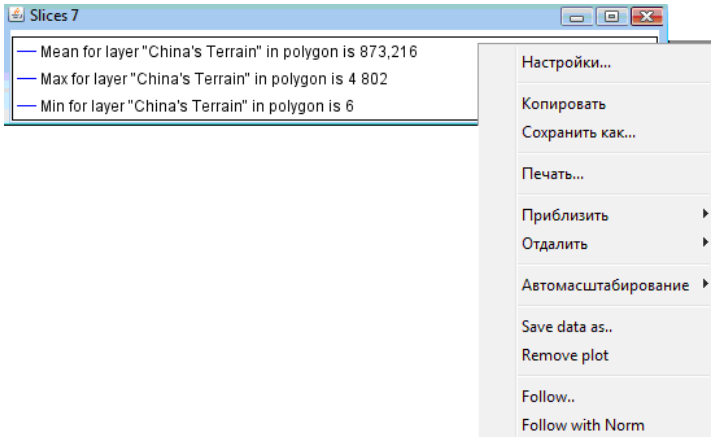


Fig. 17

By selecting the bookmark «Follow», one can see how changing the forms the polygon automatically change the grid layer statistics. Using the interface described above, you can call up the «Statistics», Fig. 16, and pick it 3D grid layer. For the 3D layer the statistics of each slice layer form a chart. The chart of 3D layers can be displayed in a separate window or in the same window, which is open to the 2D layer, Fig. 18. In the latter case, using the operation «Follow», one can analyze all statistics presented in the window.

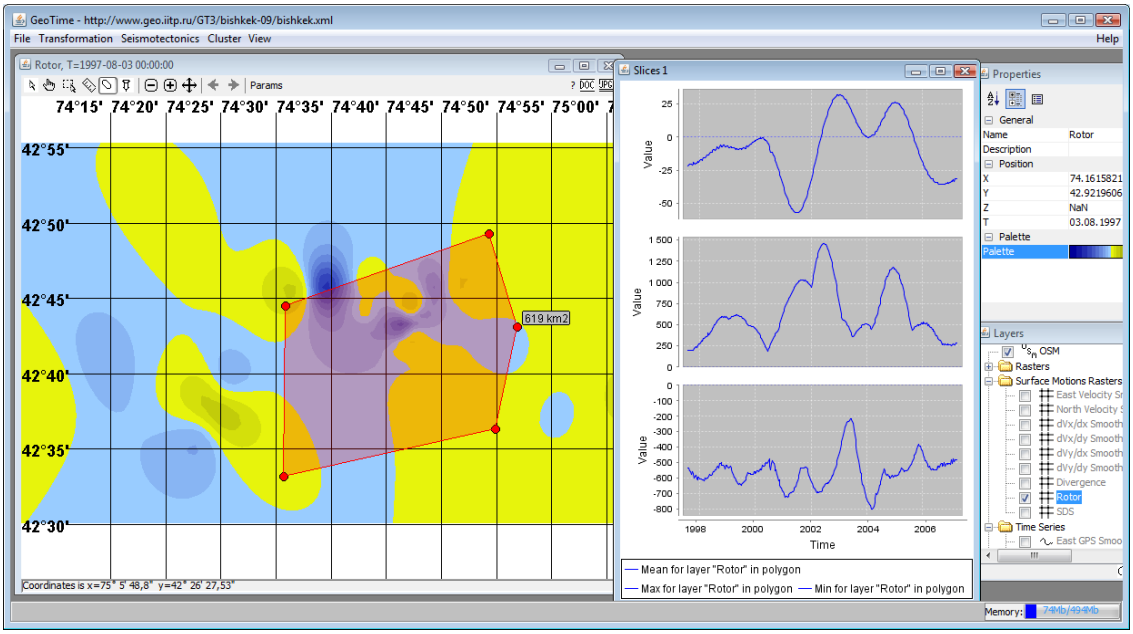


Fig. 18.

«Params». Bookmark «Params» causes a dialog box for setting the geographic projection and the grid (Fig. 19). This version has three projections: Mercator, EPGS: 4326, and Cosinus. When choosing the projections should keep in mind the following: data layers are displayed in any projection, tile maps are displayed in the Mercator projection only, WMS maps are displayed in the projection EPGS: 4326 and Cosinus. The projections of Mercator and EPGS-4326 are the standards. The projection is different from Cosinus EPGS-4326 only in that the length of the segment in the 1º along the latitude Δx is related to the length of the segment in 1º along the longitude Δy, with ratio $\Delta x = \Delta y \cos\varphi$, where φ - latitude to the middle of the displayed map.

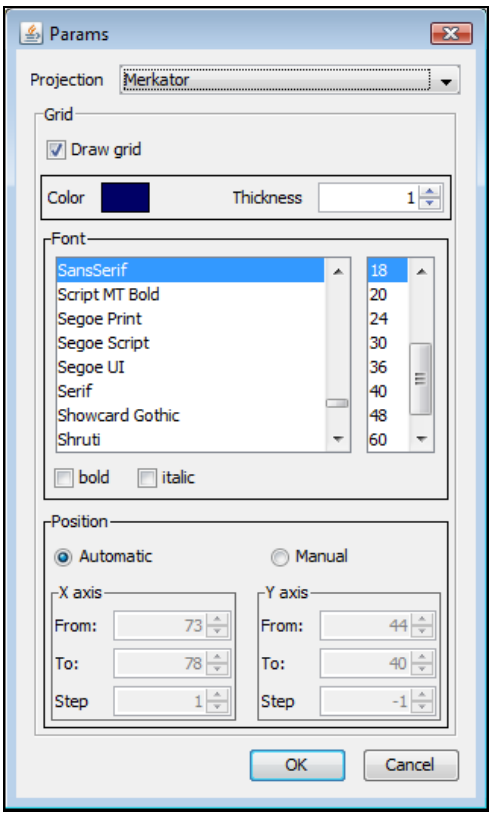
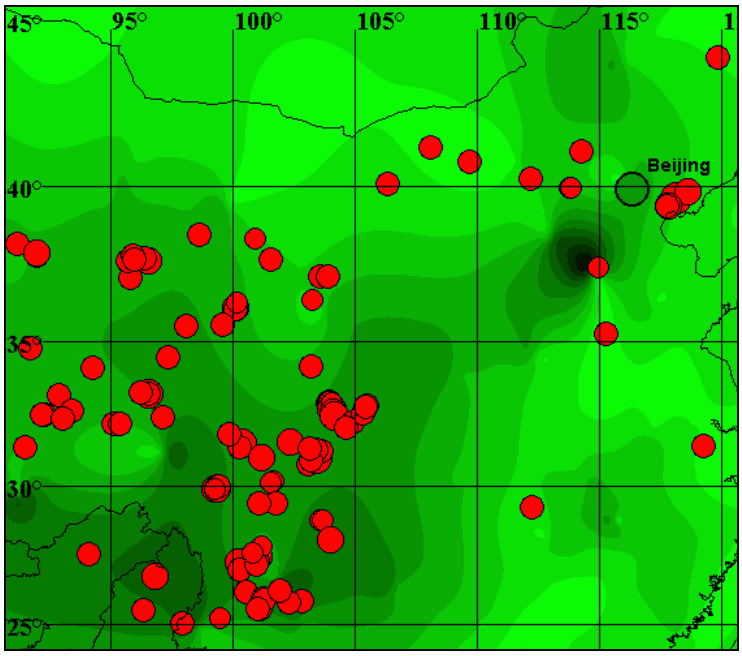


Fig. 19.

Saving a report in the format docx. Click LMB on the icon  and save the file. The resulting file can be edited by means of Word. Example of a saved file is shown in Fig. 20.

Lanzhou catalogue, 01.01.1970-31.12.2011, M>6.0



История:

[2012-05-05 15:05:34]

Создан новый растровый слой "Gradient of Moho depth of China (km)" с применением фильтра "Gradient Module" к слою "Moho depth of China (km)"

[2012-05-05 15:05:35]

В корневой каталог добавлен слой "Gradient of Moho depth of China (km)"

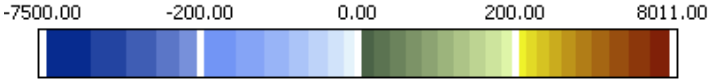
[2012-05-05 15:08:03]

Слой "Gradient of Moho depth of China (km)" перемещен в "F Lines"

[2012-05-05 15:08:16]

Слой "Gradient ofMoho depth of China (km)" перемещен в корневой каталог

Палитра для слоя "China's Terrain"



Палитра для слоя "Gradient of Moho depth of China (km)"

Fig. 20.

Saving the map image in JPG-format. LMB click on the icon  (upper right part of the mapping window.) After that, you must choose a directory to save the map image in the selected cartographic window XY (XZ, YZ, XT, YT, ZT) in format JPG.

2.4.«Layers»: the window of geoinformation layers

Window «Layers» represents a hierarchical list of source and calculated layers of the executable GIS project (Fig. 21). The order of layers on the map is defined by a sequence of layers in the list: the top layers correspond to the lower layers of the map. Layers, whose names are written in black font are loaded on your PC. The other layers of the list «Layers», are not loaded.

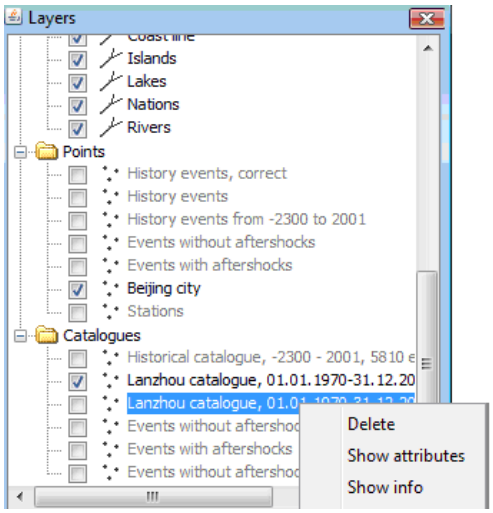


Fig. 21.

Loading and displaying a layer on the map. To download and/or display a layer its name should be marked by a. To remove the layer from the map you have to turn off the checkmark. Data loading process does not block GeoTime 3.0.

Activation of the layer. To activate the layer, it is necessary to click LMB on the layer name. The name of the active layer is tinted blue.

Changing the order of the layers. To change the order of the layers it is necessary to click LMB on the layer name and drag the cursor to the new position of the layer or to a line with the name of layer's group (such as in Fig. 21 «Rasters» or «Catalogues»).

Removal of the layer. Click RMB on the layer name. Then in click LMB in the line «Delete» of a pulldown (Fig. 21, right).

Reading the attributes of the layer (for any vector layers). Click RMB on the layer name. Click LMB in the line «Show attributes» of a pulldown (Fig. 21, right). A window «Attributes for <name of the active layer>" appears. When you move the cursor in the map window, in the window «Attributes for <name of the active layer>» the attributes of the nearest to the cursor objet are displayed. To exit the option click «Search». The window is closed by pressing the «OK».

Export (only for the sequences or series). Click RMB on the layer name. Click the line «Export» of a pulldown (Fig. 22). File with the extension tsa will be saved (in the example in Fig. 22 it is the file d:\GeoTime\export.tsa). The file contains all the sequences (rows) of the layer in ASCII.

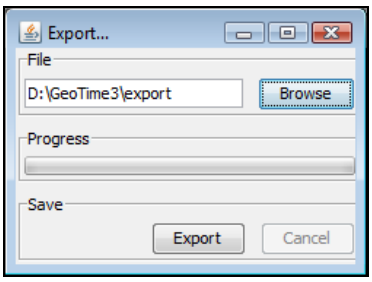
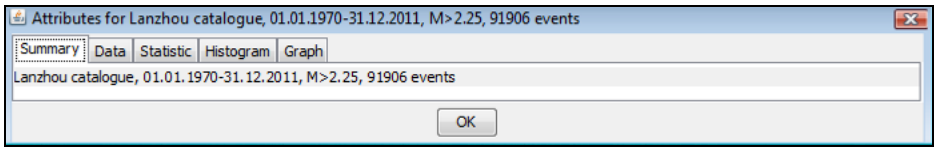
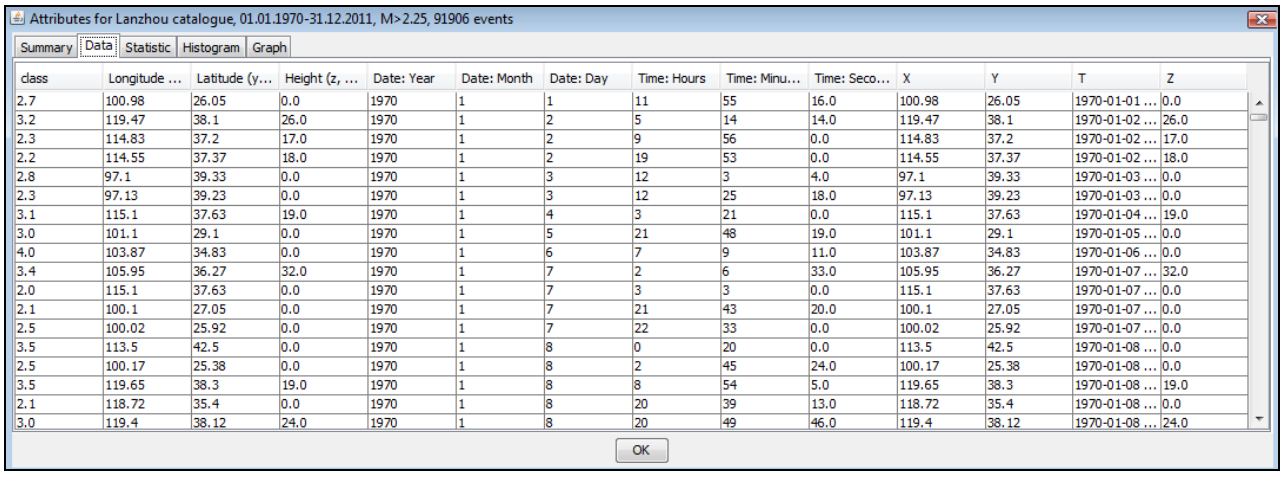


Fig. 22.

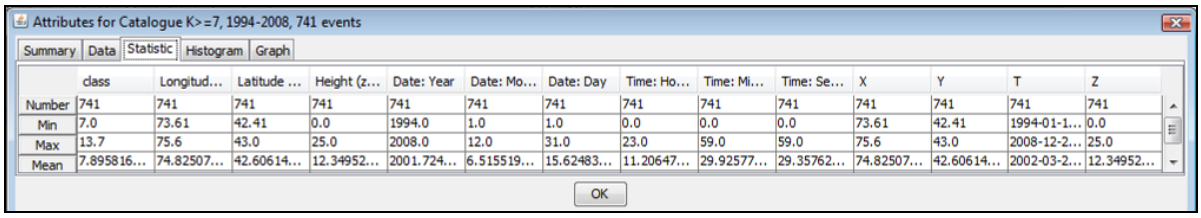
Viewing attribute information of the layer (for any vector layers). Click RMB on the layer name. Click the line «Show info» of a pulldown (Fig. 21, right). A window «Attributes for <name of the active layer>" appears. Enter the text in the tab «Description» (optional). Bookmark «Data» allows to view the attribute table for all objects of the layer (Fig. 23). Bookmark «Statistics» displays a table of the layer statistics: Minimum, Maximum, Mean and Variance (Fig. 24). Bookmark «Histogram» displays a histogram of the selected attribute in a chart or table form (Fig. 25). The parameters of the histogram values are minimum, maximum and number of intervals. Bookmark «Grahp» displays a chart of the two selected attributes (Fig. 26). In addition, the two attributes of the layer can be represented in the diagram by changing the size and paint of the icons. In the options «Grahp» and the «Histogram» by PTP a visualization control window can be called.





class	Longitude ...	Latitude (y...	Height (z, ...	Date: Year	Date: Month	Date: Day	Time: Hours	Time: Minu...	Time: Seco...	X	Y	T	Z
2.7	100.98	26.05	0.0	1970	1	1	11	55	16.0	100.98	26.05	1970-01-01 ...	0.0
3.2	119.47	38.1	26.0	1970	1	2	5	14	14.0	119.47	38.1	1970-01-02 ...	26.0
2.3	114.83	37.2	17.0	1970	1	2	9	56	0.0	114.83	37.2	1970-01-02 ...	17.0
2.2	114.55	37.37	18.0	1970	1	2	19	53	0.0	114.55	37.37	1970-01-02 ...	18.0
2.8	97.1	39.33	0.0	1970	1	3	12	3	4.0	97.1	39.33	1970-01-03 ...	0.0
2.3	97.13	39.23	0.0	1970	1	3	12	25	18.0	97.13	39.23	1970-01-03 ...	0.0
3.1	115.1	37.63	19.0	1970	1	4	3	21	0.0	115.1	37.63	1970-01-04 ...	19.0
3.0	101.1	29.1	0.0	1970	1	5	21	48	19.0	101.1	29.1	1970-01-05 ...	0.0
4.0	103.87	34.83	0.0	1970	1	6	7	9	11.0	103.87	34.83	1970-01-06 ...	0.0
3.4	105.95	36.27	32.0	1970	1	7	2	6	33.0	105.95	36.27	1970-01-07 ...	32.0
2.0	115.1	37.63	0.0	1970	1	7	3	3	0.0	115.1	37.63	1970-01-07 ...	0.0
2.1	100.1	27.05	0.0	1970	1	7	21	43	20.0	100.1	27.05	1970-01-07 ...	0.0
2.5	100.02	25.92	0.0	1970	1	7	22	33	0.0	100.02	25.92	1970-01-07 ...	0.0
3.5	113.5	42.5	0.0	1970	1	8	0	20	0.0	113.5	42.5	1970-01-08 ...	0.0
2.5	100.17	25.38	0.0	1970	1	8	2	45	24.0	100.17	25.38	1970-01-08 ...	0.0
3.5	119.65	38.3	19.0	1970	1	8	8	54	5.0	119.65	38.3	1970-01-08 ...	19.0
2.1	118.72	35.4	0.0	1970	1	8	20	39	13.0	118.72	35.4	1970-01-08 ...	0.0
3.0	119.4	38.12	24.0	1970	1	8	20	49	46.0	119.4	38.12	1970-01-08 ...	24.0

Рис. 23.



	class	Longitud...	Latitude ...	Height (z...	Date: Year	Date: Mo...	Date: Day	Time: Ho...	Time: Mi...	Time: Se...	X	Y	T	Z
Number	741	741	741	741	741	741	741	741	741	741	741	741	741	741
Min	7.0	73.61	42.41	0.0	1994.0	1.0	1.0	0.0	0.0	0.0	73.61	42.41	1994-01-1...	0.0
Max	13.7	75.6	43.0	25.0	2008.0	12.0	31.0	23.0	59.0	59.0	75.6	43.0	2008-12-2...	25.0
Mean	7.895816...	74.82507...	42.60614...	12.34952...	2001.724...	6.515519...	15.62483...	11.20647...	29.92577...	29.35762...	74.82507...	42.60614...	2002-03-2...	12.34952...

Рис. 24.

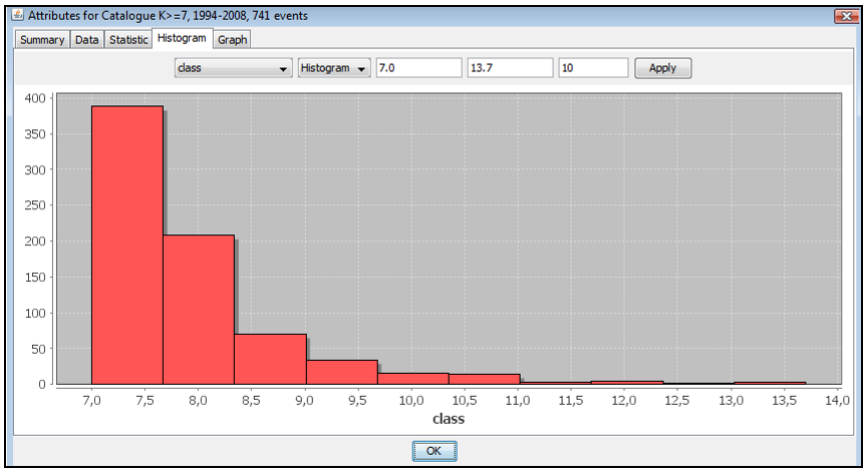


Рис. 25.

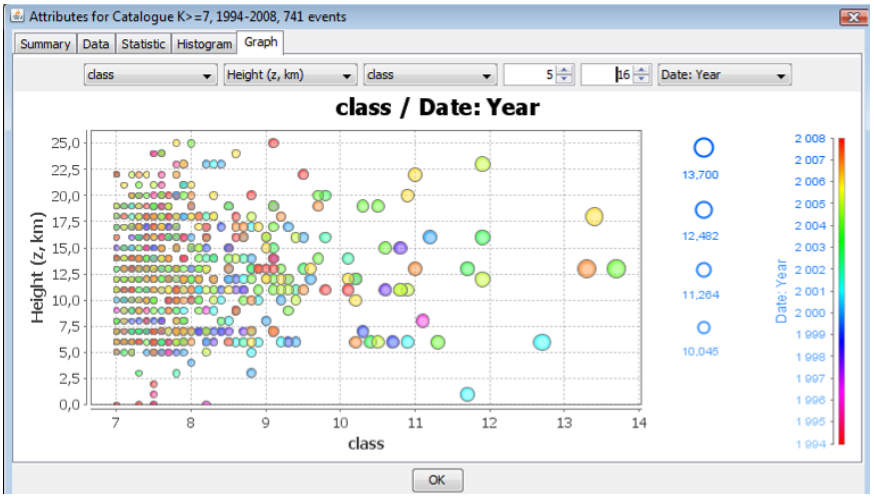


Рис. 26.

Measure the area of polygons. Click RMB on the name of the polygon layer. Click LMB on the line «Show area» of a pulldown. A window «Area for <name of the active layer>", which shows the area of polygons, selected when the cursor is in the map window.

If, in addition, the button «  » of the visual Control Panel is pressed, then the selected polygon will be highlighted.

2.5. «Properties»: the window of attributes

The window «Properties» is intended for a management of cartographical presentation of the layers. Operations are performed only with the active layer attributes. Therefore, at first, it is necessary to activate a required layer.

Notes:

- The active layer may not apply to the layers that are selected to construct the map.
- Type of the window «Properties» depends on the layer type.
- Operations with attribute visualization usually initialized by the button « [...] », that appears when you press the LMB on the right side panel of the operation. If the button does not appear, it is necessary to click LMB in the title bar of the list of transactions and then to click again LMB on the right side of the panel.

2.5.1. Management of scalar grid-based layer visualization

The windows of the scalar grid based layer attribute visualization management are shown in Fig.27: on the left is a window for the 2D layer, to the right – for the 3D layer.

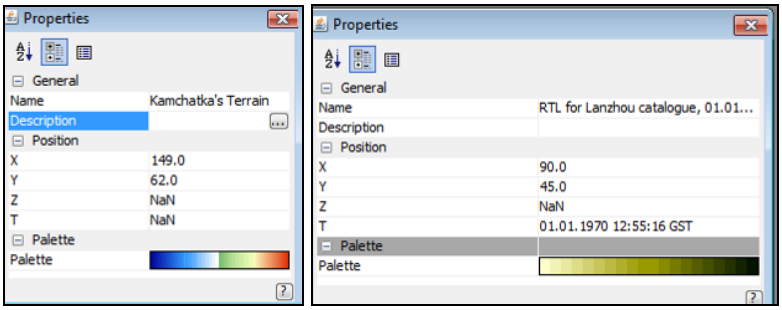


Рис. 27.

The title «*General*» contains two panels: the name of the layer «Name» and a description of the layer, «Description». The bookmark «Description» is opened by LMB on the right side of this panel. At the same time the butt[...]« » appears. If the button does not appear, you must click LMB on the title bar line («General») and then re-click LMB on the right of the line item («Description»). After that, the button « [...] » appears and you can open a window «Description». Description of the layer in the window can be edited.

The title «*Position*» contains four panels, which contain a fix of the layer. In the case of 3D and 4D fields, these panels are used to launch an animated visualization the relevant axes of the layer coordinates. Fig. 28 shows a fragment of 3D visualization layer (it is shown a slice of 3D layer of density of earthquake anomalies in the background terrain model). Animation is running on the axis T (time). The animation control window is at the top. The button «>» runs animation «forward» in time, the button «<» - «back»; the button «OK» - the window is closed; the button «export» save the animated maps in GIF or AVI files. Management of the animation can be done with the mouse and keyboard. To do this, click LMB on the slider and drag slider by cursor or control it position with the keys «←», «→».

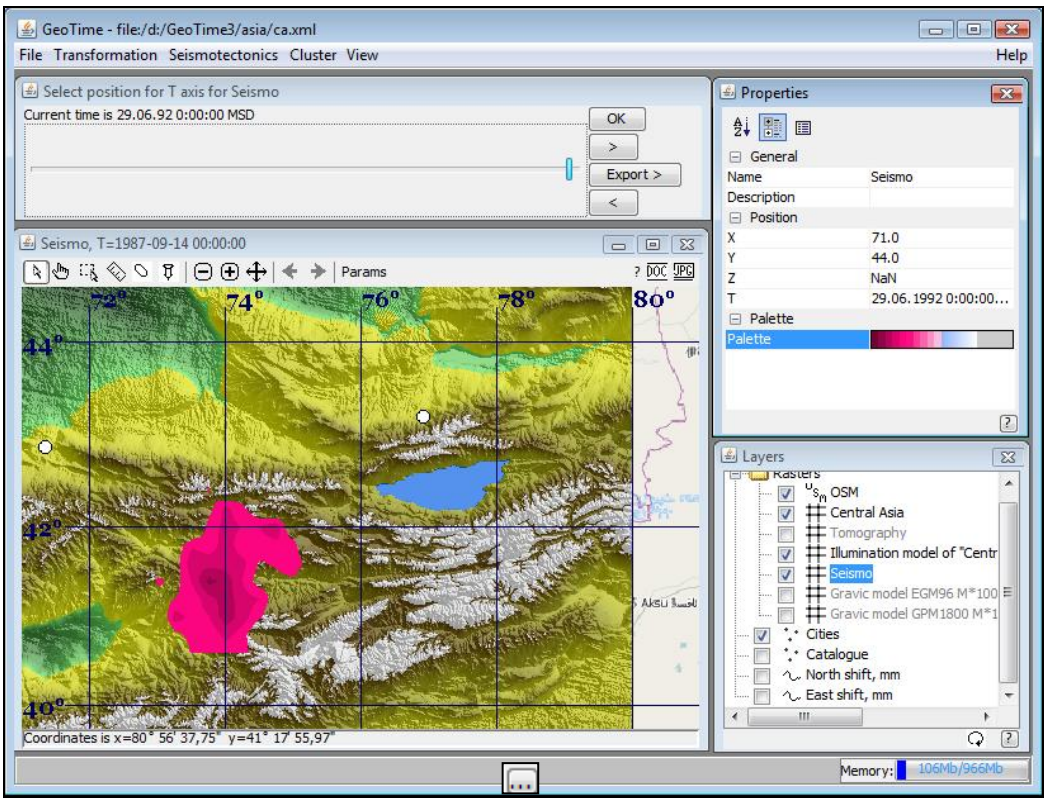


Fig. 28.

The title «*Palette*» selects the panel «Palette», which runs filling the layer. The bookmark is opened by LMB on the right side of this panel using the button «...» (Fig. 29).

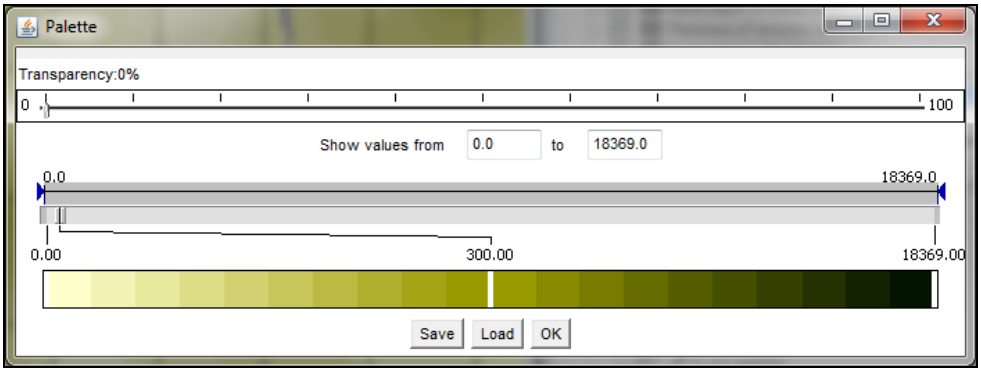


Fig. 29.

In the box Fig 29 you can set transparency of the layer, select the range of visualized values, filling interval, and select the layer filling.

The transparency slider is set by the slider at the first line.

The choice of range for the visible part of the grid layer and the intervals of the values in the color layer spacing is executed on the second line (the range is set at the top part of the line, the intervals are set at the bottom part of the line).

The third line handles the filling of a grid layer. When you click LMB on the edge range of color interval, a window «Select color» appears (Fig. 30). Colors in the interval are interpolated between the colors on its borders in the scales of RGB, HSB, RHSB. When dragging the cursor with pressed LMB from one to the other boundaries of the interval the uniform filling is set for all values of the interval.

There are 4 tool of setting colors and transparency for each interval: «Swatches», «HSB», «RGB», «Alpha Channel». In the windows color and transparency are selected for the appropriate boundaries of the interval. Transparency varies sub-band as well as other

components of the color: Alpha - the transparency coefficient, a value of 0 on the scale of transparency is fully transparent, 255 is opaque.

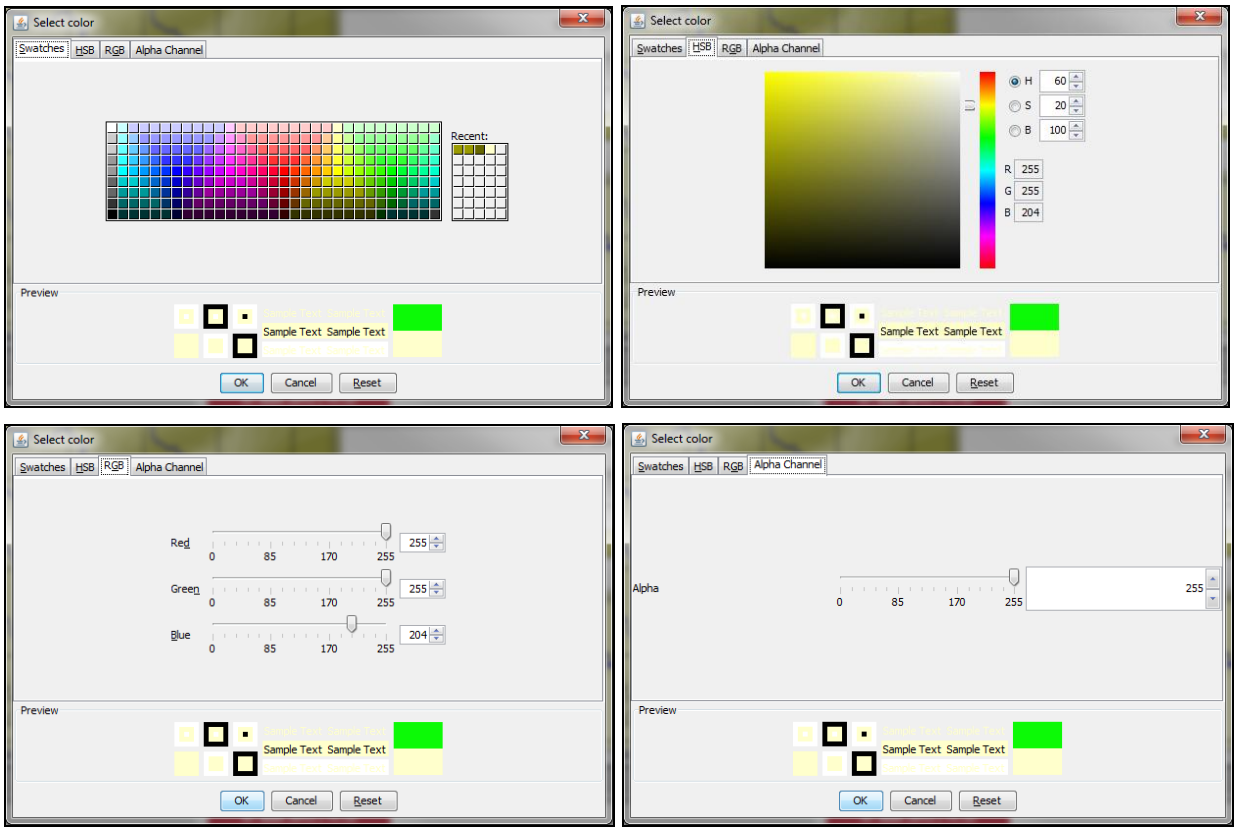


Fig. 30.

Pressing the LMB in the middle of the interval the color scale window (Fig. 29) the window «Get parameters» appears (Fig. 31). In the left pane, you can choose a color scale filling: RGB, HSB, RHSB. On the right side - to represent the scale: linear (Linear), logarithmic (Log) and exponential (Exp). Downstairs, in the «Steps», a number of the color intervals is selected.

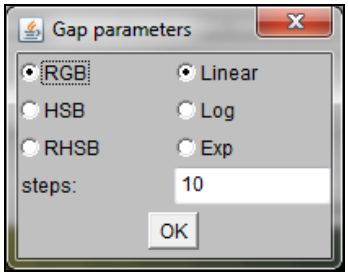


Fig. 31.

Pressing the LMB in the intervals between the color intervals of the window Fig. 29, a window «Change value» appears for setting the numeric value of the color boundaries of the interval (Fig. 32).

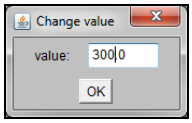


Fig 32.

The title «Position» (animation control). On the right in panels X, Y, Z, T the animation control buttons are located. For example, the button T has been pressed. A window «Select time for <name of the active layer>" (Fig. 33) appears. Start and stop of animation may be control by

the buttons «>», «<», and «| |». To view a certain slice you can move a slider or cursor using the mouse or keyboard. To save files in GIF or AVI you have to use the button «Export».

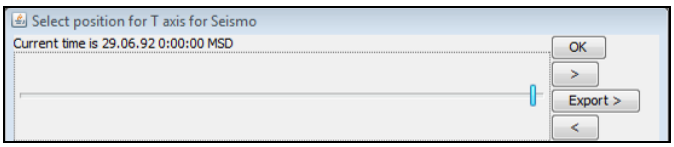


Fig. 33.

The button «Export» opens the window «Export to movie». The option «Save in AVI» allows you to save the animation in AVI-file. Option «Looped» allows you to save animations in GIF-file. By default, the only the map is saved. When you select the button «Capture Full Window» the whole GeoTime window is saved. Panel: «Delay (in msec)»: setting the delay interval between frames of animation.

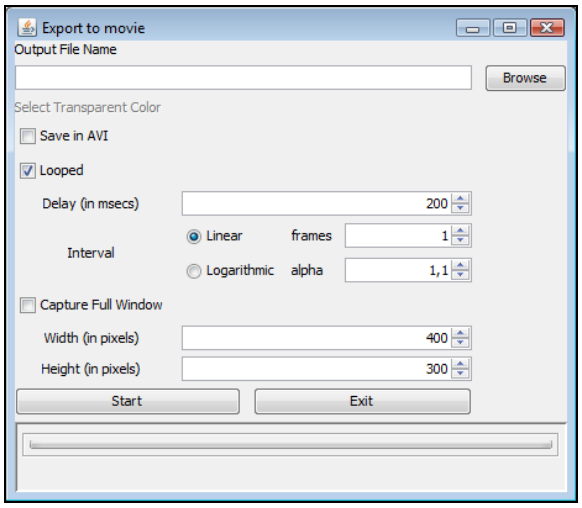


Fig. 34.

2.5.2. Management of vector grid-based layer visualization

Two windows for management of a vector grid-based layer visualization and a slice of the vector grid-based layer are shown in Fig. 35.

Management of visualization in the window «Properties» is very similar to Section 2.5.1.

The title «*General*» contains two panels: the name of the layer «Name» and a description of the layer, «Description». The bookmark «Description» is opened by LMB on the right side of this panel. At the same time the button « [...] » appears. If the button does not appear, you must click LMB on the title bar line («General») and then re-click LMB on the right of the line item («Description»). After that, the button « [...] » appears and you can open a window «Description». Description of the layer in the window can be edited.

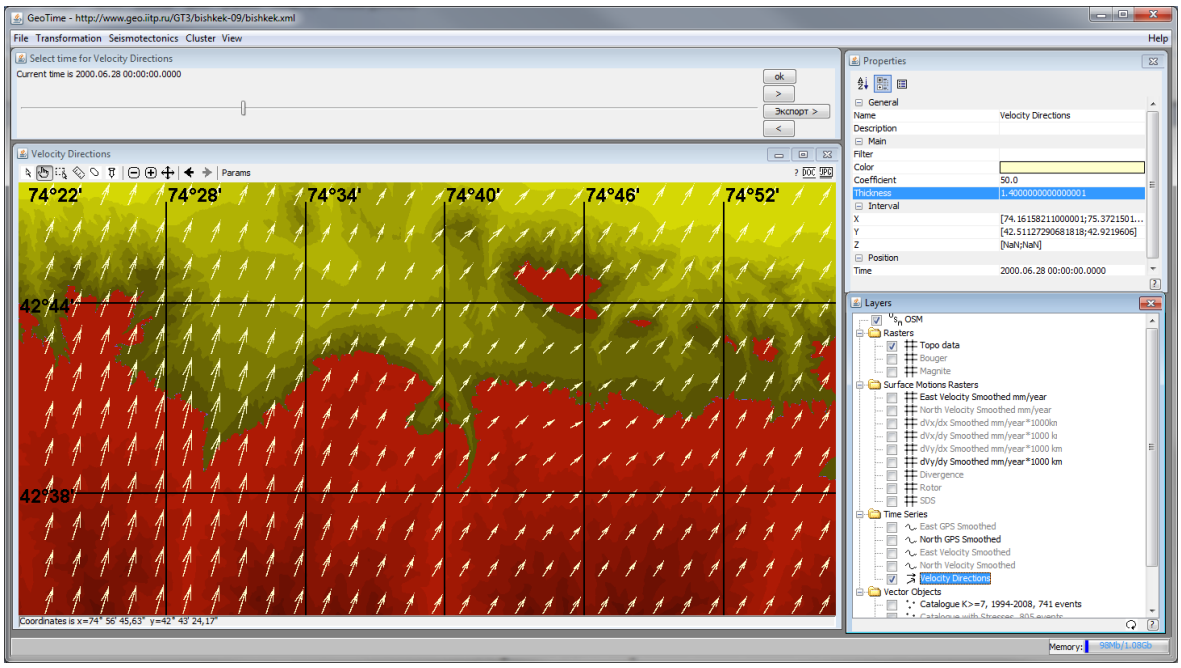


Fig. 35.

The title «Main» consists of three panels. Operations are performed on the layer attributes (Fig. 36). Panel «Filter» allows to select a subset of the vector objects using such operations as >,> =, =, <, <= etc (a complete list of operations is given on the site http://www.vedu.ru/programming/index.asp?cont=articles&articles_id=147). It is possible to display a subset of the objects (the button «Apply») or to save it as a new layer (the button "Sreate subclass»).

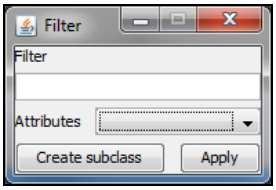


Fig. 36.

The panel «Color» controls the filling options of the layer. After clicking the LMB on the panel «Color» a window «Select color» appears (Fig. 37).

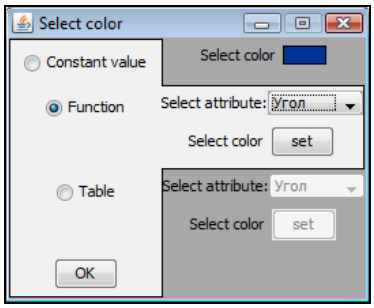


Fig. 37.

The window allows you to choose one of three filling options: «Constant value» is to fill equal all vectors, «Function» is to fill the objects depending on the value of a numeric attribute, «Table» is to fill the objects, depending on the tabulated values of the attribute.

The control buttons are located in the right part of the window.

The option «Constant value». The tab «Select color» opens the filling option window «Select value» (Fig. 30).

The option «Function». Tab «Select attribute» allow to select an attribute, the values of which will be used for filling. Button «Select color» opens a filling option window «Palette» (Fig. 29).

The option «Table». The tab «Select attribute» allow to select an attribute, the values of which will be used for filling. The button «Select color» opens the next window for filling if the number of attribute values less than 100.

The panel "Coefficient." After clicking the LMB on the panel «Coefficient», the window «Set size» for setting the length of arrows appears (Fig. 38).

The window allows you to choose one of three filling options: «Constant value» - to set the same size for all vectors, «Function» - to set the size of the objects depending on the value of a numeric attribute (Fig. 39), «Table» - to set the size of the objects depending on the tabulated values of the attribute.

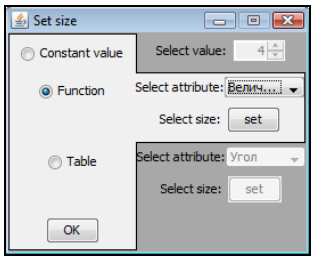


Fig. 38.

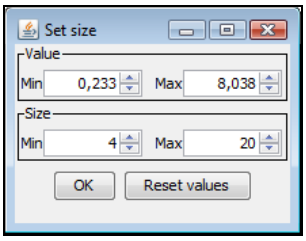


Fig. 39.

The panel «Thickness». After clicking the LMB on the panel "Coefficient" the window «Set size» of arrows thickness setting appears (Fig. 40). The options «Constant value», «Function» and «Table» similar to the options of window Fig. 38.

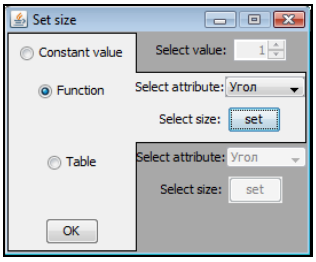


Fig. 40

The title «Position» (animation control). On the right in panels X, Y, Z, T the animation control buttons are located. For example, the button T has been pressed. The window «Select time for <name of the active layer>" (Fig. 33) appears. Start and stop of animation may be done by the buttons «>», «<», and «| |». To view a certain slice you can move a slider or cursor using the mouse or keyboard. To save files in GIF or AVI you have to use the button «Export».

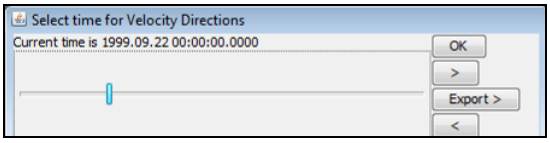


Fig.. 41.

2.5.3. Management of line layer visualization

The window «Properties» (Fig. 42), contains the following headings: «General», «Description», «Main», and «Interval».

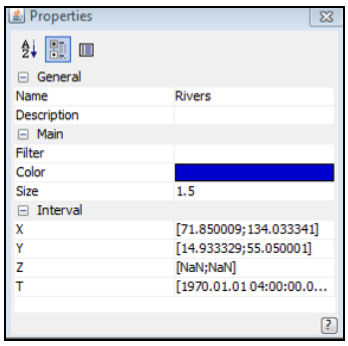


Fig. 42.

The management interface is similar to the interface, which is described in section 2.5.2.

2.5.4. Management of polygon layer visualization

The window «Properties» (Fig. 43), contains the following headings: «General», «Description», «Main», «Interval», and «Border».

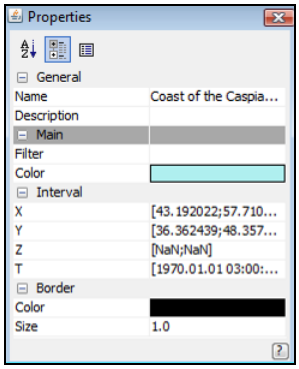


Fig. 43.

The management interface is similar to the interface, which is described in section 2.5.2. Bookmark «Main» contains the attribute «Color», which controls polygon color-filling.

2.5.5. Management of point layer visualization

The window of point layer visualization is shown in Fig. 44.

The management interface is similar to the interface, which is described in section 2.5.2. – 2.5.4. We consider only the additional headers and panels.

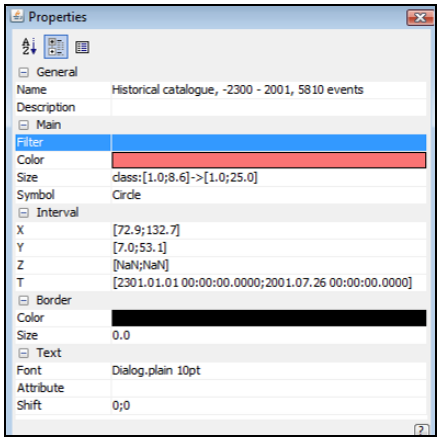


Fig. 44

The panel «Symbol» allows you to select the appropriate icon to indicate the points of the active layer: «Circle», «Square», «Triangle», «Cross» (Fig. 45). The coordinates of the points coincide with the geometric center of the icon for «Circle», «Square», «Cross». For «Triangle» option the coordinates of the points are coincide with the lowest vertex of a triangle.

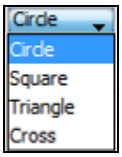


Fig. 45

The title «Interval» (animation control). On the right in panels X, Y, Z, T the animation control buttons are located. For example, the button T has been pressed. A window «Select time for <name of the active layer>" (Fig. 46) appears. In the window you can change the width of the slider moving the cursor or by changing the values in the panels «From» and «To», to change animation step or the number of animation frames in the panels «Step» or «Frames», start and stop of animation may be done by the buttons «>», «<», and «| |». To view a certain slice you can move a slider or cursor using the mouse or keyboard. To save files in GIF or AVI you have to use the button «Export».

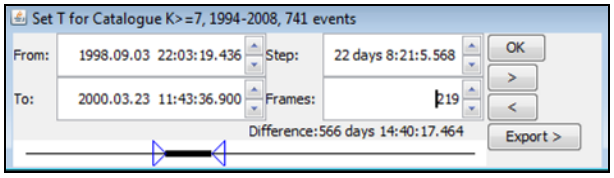


Fig. 46.

The title «Border» contains control panels for setting color and width of the border icon. Interface operations management panels «Color» and «Size Thickness» the interface is similar to the operations of the title «Main».

The title «Text». Panel: «Font» controls the setting of the font for the label. «Attribute» controls selection of the display attribute. Panel «Shift» controls shift of the text with respect to the point.

2.5.6. Management of tile map visualization

Displaying tile maps is performed only in the Mercator projection (Section 2.3, the tab «Params»).

In this version you can display the tile maps OSM, OSM Mapnic, Yandex People's Map, Wikimapia, Космоснимки официальные. In principle, the program supports mapping and other satellite images and maps. However, this requires official approval of their respective companies.

To display a tile map it is required to perform the following steps:

- Set the Mercator projection (see Section 2.3, the tab « 

»).
- Activate the layer of OSM (in the window «Layers»).
- Click LMB on the button «OSM», and then choose the desired map from the drop-down list.

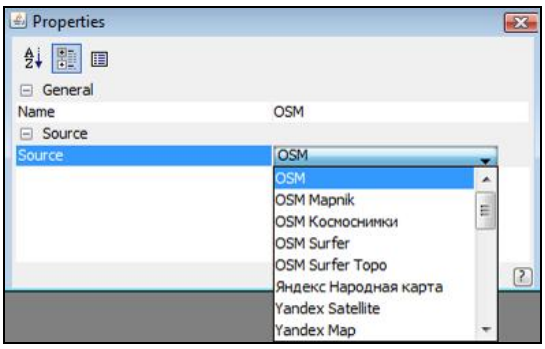


Fig. 47.

2.5.7. Management of WMS map visualization

Displaying WMS maps is possible in the projections EPGS: 4326 and Cosinus (see Section 2.3, the tab «Params»).