The Use of Information Technologies for Processing of Materials of Field Surveys

E A Kosheleva¹, S AKoshelev²

¹Herzen State Pedagogical University, 191186, Moika river embankment, 48, case of 12, St.-Petersburg, Russia
²JSC «Concerns «Okeanpribor»», 197376, Chkalovsky prospect, 46, St.-Petersburg, Russia

E-mail: koshelevaelen@yandex.ru

Abstract. Data processing and subsequent visualization is currently one of the leading values in field studies. The application of geographic information technologies (GIS) greatly simplifies these processes. The article gives a brief overview of the main software currently used to integrate the information into databases, its analysis and translation of paper maps into digital form with the creation of maps of actual material in 2D. The capabilities of this software for real-time data processing and 3D modelling are limited. The author's program "LAB-POLYGON" version 5.1, developed for documenting and visualizing field research data, allows for multifunctional processing, including in real time.

1. Introduction
Currently, scientific research is paid great attention to the treatment and presentation of various data of field research. Modern requirements include not only graphical analysis of statistical results, but also a visual representation of the study area using GPS-Navigator data, graphical schemes of sections, stratigraphic columns of sediments and other documentary evidence of the research.

2. Brief overview of the software
Modern programs that allow processing of field studies can be divided into two groups. The first group includes software installed / partially installed on a desktop computer. It stands out:
1. Packages GIS:
   - Raster – Idrisi, ERDAS, GRASS. Information about natural objects is essentially raster (mosaic) [7], and these GIS packages allow you to create and analyse geographic data.
   - Vector – ArcView and MapInfo. They are convenient for working with vector data; allow creating databases and conducting sample analysis [8]. Based on raster GIS data.
2. Statistical data processing programs – Mat Lab, Microsoft Excel and others. Allow you to build and analyse graphs, charts.
3. Field research data visualization programs:
   - Tillia IT – used for plotting palynological spectrum [9];
   - Strater – used to plot stratigraphic sections of sediments in 2D.

The second group of software is related to online Internet resources. The most famous and recognized services are Google Maps, Google Earth and NASA World Wind, containing information
on the entire earth's surface. The interactive online maps provided by them are also based on GIS, as they work with spatial data and allow you to find any point on the ground. They display not only familiar map information, but also space images taken from a remote sensing database, and in the case of Google Earth and NASA World Wind - even with detailed three-dimensional visualization. Can be used to create maps of the study area.

The above brief analysis of the software shows the narrow specialization of most programs. In addition, their ability to process real-time data and build 3D models is limited.

3. Statement of a problem
Climate warming leads to degradation of permafrost and the complete disappearance of the ice. In that territory in a widespread thermokarst processes wedges and ice in the cracks as thawing replaced deposits swim top. This form of "cracks" has become known as pseudomorphosis [1].

During three years (1995-98) paleopseudomorphs investigated at the landfill of P-1 on the watershed of the rivers Luga and Plyussa in the podzol Al-Fe-humic. They pronounced in the illuvial horizons, extend to a depth of 1.0 -1.8 m and usually reach of underlying moraine (Figure 1).

![Figure 1. Pseudomorphs in the podzol Al-Fe-humic.](image)

In our opinion, the formation of frost cracks likely to have happened in the Late Glacial [2, 3, 4]. For the study has been applied a technique of polygons. Kosheleva E.A. has developed a author's method of detailed mapping pseudomorphs [3] in 1:10 scale, allowing to see the features of their of placement. The main task was to fixing the boundaries of horizons A2 and Bhf.

Filling the pseudomorphoses happened friable sandy sediments, and on contact with the day surface formed a small decrease nanorelief. These factors promoted formation of powerful podzolic horizon (A2) in place frost cracks. In their walls, in contact with a relatively solid rock, there was precipitation of iron-humic and an aluminum-humic compound that is was formed considerably cemented illuvial horizon (Bhf). This horizon is different from horizon A2 by other water-air and physical properties: density, conductivity [4].

As a result, a detailed mapping of the walls of the polygon author created a matrix of power podzolic horizon and pseudomorphoses. On the basis of data it is possible to obtain vertical plane, horizontal plane, stepwise sampling the polygon or diagonal cut at any depth. Execution of graphic
processing of such data requires not only the large amount of time, but also the ability to draw. Besides difficult to build 3D-model.

Additional studies (2009-2011 years) had allowed increase the number polygons to 5 [4]. Required major data processing research, which "manually" would last a long time [5].

4. Used equipment and software
For processing the data matrix the polygon P-1 with the goal of building 3D-images of soil-geomorphic incisions in 2009 was used by the author's program «Lab-Poligon», developed by graphic LabVIEW environment of the company «National Instruments» [5].

The choice of the graphical environment of LabVIEW programming stems from the fact that the use of LabVIEW allows reducing time to create the finished program tenfold compared to conventional "text" programming languages such as Visual Basic. At the same time, 90% of software engineer using LabVIEW is used in the solution of the problem, not the creation of complex screen forms for the convenience of the user, which is typical for the "text" of programming languages. Program since 2009 supplemented and corrected for the initial version 1.0 was used LabVIEW 8.5; currently version 5.1 is designed to LabVIEW 2011 [6].

5. Description of the solution of the problem
Program «Lab-Poligon» allows you to:
- Construct a 3D-image (three-dimensional image in the coordinates X, Y, Z) from the experimental data given in the form of a matrix or array data. 3D-image can be plain or multi-color (Figure 2);
- Construct 2D-images (on a planar coordinates X, Y, Z for each pair of coordinates);
- Printing 2D-images and 3D-image: monochrome, multi-color and black-white;

Figure 2. 3D-image of the experimental data the polygon P-1, given an array of data on the depth of the lower limit of the horizon A2h + A2.

- Get a horizontal plane the study area at any depth;
- To receive the horizontal and vertical planes, according to user-specified criteria for the program;
- Record baseline data into the database;
- Reading data from the database and their comparison, including graphically (as in the 2D-image) with the other data on the polygon.
6. Conclusion

Program «Lab-Poligon» Version 5.1 has an additional SubVI, designed to work with the board NI USB-6259, which in turn can be connected to the georadar. In this case, possible to create a portable mobile complex for electromagnetic sensing. Electromagnetic sounding method has been successfully applied to determine the power of seasonal thawing layer, revealing silt and clay horizons, determine the depth of the bedrock and the upper edge of the highly conductive ore bodies, determining the power of peat deposits, as well as for archaeological research.

At geophysical measurements research more often carried by a system of parallel profiles. Measurement of parallel profiles at the landfill usually associated with the need for preliminary contouring place of research and the compulsory refund to the starting point for measuring the next profile. This is the way operation of most graphics packages data processing, intended for solution this problem. Program «Lab-Poligon» Version 5.1 allows the researcher not only the ability to process data in real time, but when connect a special option, move like a "snake" that significantly reduces the time research works. Supplement program «Lab-Poligon» SubVI, responsible for data processing of geodetic satellite receivers, taking cues from global space navigation system GLONASS (Russia) and/or Navistar GPS (Navigation Satellite Timing and Ranging Global Positioning system, USA), will increase the precision of research.

7. References

[1] Romanovsky N N 1977 Formation poligonalnozhilnyh structures (Novosibirsk, Nauka)
[2] Ignatenko I V, Kosheleva E A and Shekoldina I V 1995 Manifestation of cryogenic soils in southern taiga subzone of the North-West of Russia (III Zjazd geomorfologov Polskich. 1: Streszczenia Komunikatow, posterow I referatow. WNoZ US, SGP, Sosnowiec) p. 86-87.
[3] Ignatenko I V, Yurenkov G I, Kosheleva E A and Mosin V G 1999 Restoration of land cover and manifestation PALEOCRYOGENESIS in landscapes Blendovskoy desert (southern Poland) and geographic station RSPU. Herzen "Iron" (North-West of Russia) (SPb : Herzen University)
[4] Kosheleva E A 2012 The evolution of the landscape of the boreal zone in the Late Glacial and Holocene. (SPb : Herzen University)
[5] Kosheleva E A and Koshelev S A 2010 Problem 3-D graphics polygonal structures on the example of pseudomorphs over re-veined ice. // Geology, geo-ecology, evolutionary geography. Collection of scientific works / ed. Nesterov E M (SPb : Herzen University) p. 251-253
[6] Kosheleva E A and Koshelev S A 2014 Studying and 3-D modeling pseudomorphs after ice wedges in the podzols Al-Fe-humic // Proceedings of the Scientific Conference on Archaeological Soil Science. (Pushchino: Institute of Physics-chemical. and biologist. Problems of Soil Science) p. 126-129
[7] Litinsky P Yu 2007 Three-Dimensional modeling of the structure and dynamics of taiga landscapes (Petrozavodsk: Karelian scientific center RAS)
[8] MapInfo Professional 11.0. User manual 2011 (Pitney Bowes Software Inc., One Global View, Troy, New York)
[9] Tilia I T User manual https://www.tiliait.com