

*International Field Symposium on Quaternary Geology and Landforming Processes*

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# **QUATERNARY GEOLOGY AND LANDFORMING PROCESSES**

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phenomena that the  $\gamma$  is compressing beneath the valleys and stretching in the upland areas. In the last case they spread to the greater depth (up to the twice and more altitude of the relief).

In the case of the joint action of the tectonic forces and relief, the  $\gamma$  beneath the valleys is more than the established value (proportional to rock density and to the depth from the surface), and significantly less in the upland areas. The results of the vertical tensions decreasing in the upland areas and increasing beneath the valleys (both depending on gravitational and tectonic forces) are added. In the temporal aspect the joint action of the gravitational and horizontal tectonic forces causes to interrelated ascending and descending of the blocks. In that case the valley areas descend and the top areas ascend relatively to the overall up-rising orogenic processes of the crust, inherent for the Khibiny mountain massif.

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### **GIS-TECHNOLOGIES IN STRUCTURAL-GEOMORPHOLOGICAL ANALYSIS OF THE BELARUSIAN POOZERYE AREA**

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#### INTRODUCTION

Geographical informational systems (GIS) are getting a special significance in the current development of geology and geomorphology. GIS-technologies allow to visualize landforms and geological information, as well as to carry out different kinds of geomorphological analysis (structural-geomorphological and morphometric mapping, profiling) and modelling (three-dimensional models of landforms and other structural surfaces, evaluation and prognosis of endogenic and man-caused processes).

#### METHODOLOGY

Structural-geomorphological analysis of the Belarusian Poozerye area has been realized according to the morphometric method of tectonic features recognition (after Filosofov 1975). These traditional methods have been supplemented by an application of GIS (fig. 1). Together with geomorphological data geological and geophysical information has been used in order to improve the reliability of morphometric investigations and to carry out the correlation of the recognized active neotectonic structures with the present neotectonic pattern.

#### RESULTS

Structural-geomorphological analysis of the area has been realized in the software environment of the geographical informational system ArcGis 9.0 (ESRI, USA). GIS-project "Landforms of the Belarusian Poozerye" has been originated (Kurlovich, Karabanov 2004). This project consists of following vectorial layers: topography (rivers, lakes, settlements, limits of the Poozerye), digital relief model (isoline, three-dimensional model of landforms – fig. 2), morphometric data (order of valleys, basic surfaces and their differences, top surfaces, residual landforms), structural surfaces (basement surface, surface of pre-Quaternary

sediments, underlying surfaces of the morainic and intermorainic beds), active neotectonic structures.

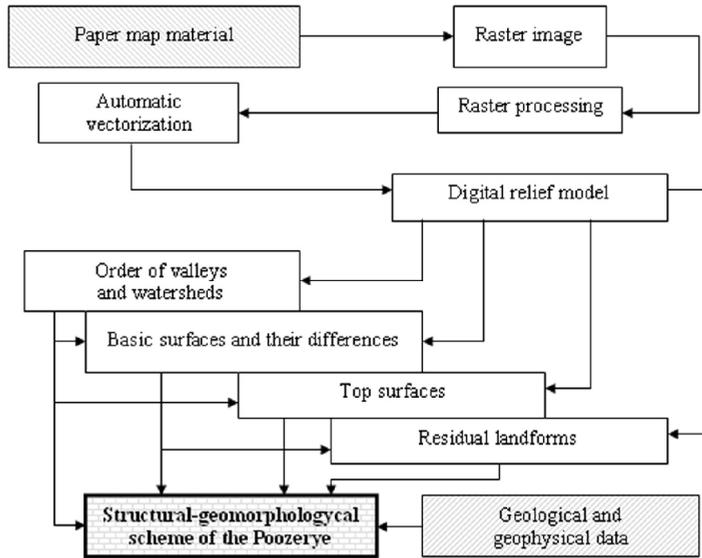


Fig. 1. Process of the structural-geomorphological analysis

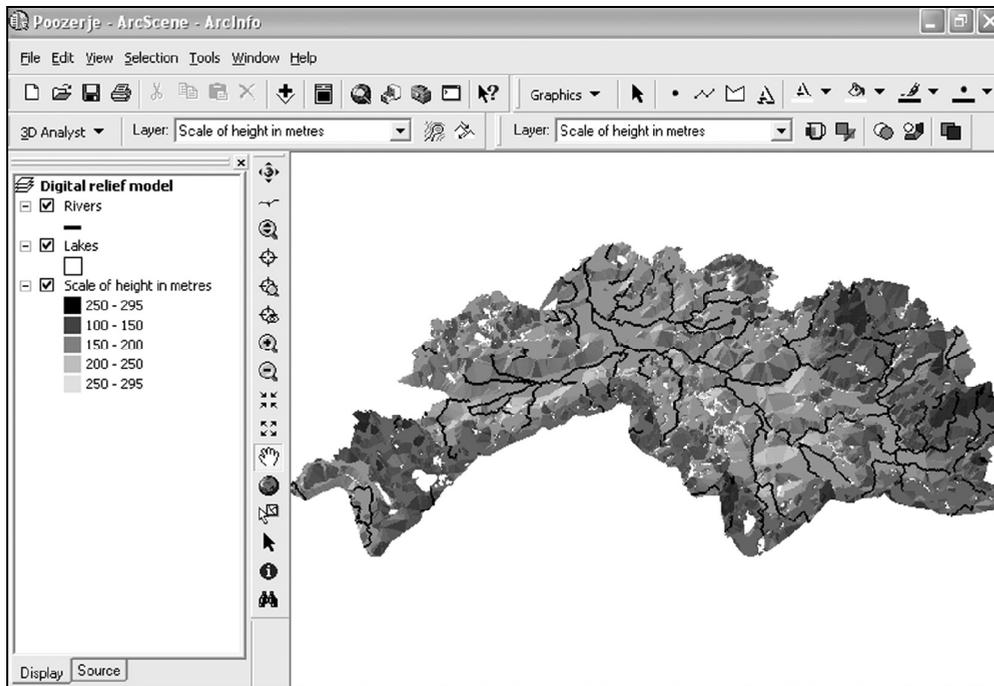


Fig. 2. Three-dimensional model of landforms of Belarusian Poozerje

As a result of GIS-analysis of the landforms, structural-geomorphological scheme of the Belarusian Poozerye has been developed.

#### CONCLUSIONS

Application of the modern GIS-technologies in study of geology and geomorphology of the Poozerye area allowed to solve several questionable problems related to structural-geomorphological peculiarities of the area. Obtained structural-geomorphological results within the Poozerye could serve as a base for geological and geomorphological mapping as well as for a human impact assessment and prevention of natural hazards. This study allowed to reveal active neotectonic features and to evaluate general seismotectonic situation.

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### **STORM EFFECTS ON THE OPEN BALTIC EXPOSED COASTAL RELIEF OF LATVIA**

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Erosion of the Baltic Sea coast, including the coast of present-day Latvia, has been occurring, in accordance with climatic trends and long-term fluctuations in sea level, already in times when people were completely helpless in the face of natural phenomena. However, changes in coastal processes have been observed during the 20th century, as a result of human economic activities, and possibly also in connection with global climate change. In connection with land prices, recreational opportunities, the threat to private and public assets, as well as restrictions on economic activities, the present state of the coast has become a subject of interest among researchers, the press and thus also the general public.

In the second half of the 20th century, several studies of a high standard, but very restricted in scope, have been undertaken on processes in the coastal zone. Most significantly, before 1992, no long-term, comparable monitoring studies were undertaken on major stretches of the open Baltic coast. Accordingly, the present study only makes use of the methodologically sound instrumental data for the period 1992–2004. During this period changes in the exposed coastal relief and in the distribution of coastal surface sediments have been affected by four especially powerful storms: in January 1993, December 1999 “Anatoly”, November 2001 and January 2005.

The erosion vulnerability of Latvia’s open Baltic coast is very varied. Thus, the natural protective barrier in front of the coast (beach + active aeolian relief) varies from less than 5 m<sup>3</sup>/m to more than 150 m<sup>3</sup>/m of sediment above sea level (Eberhards, 2003).

The volume of sediment eroded in storms has been calculated using the data obtained within the frame of the Latvian Coastal Geological Monitoring Programme. This consists of two datasets: levelling measurements using an optical level on an annual basis (63 profiles) and ordinary measuring