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PRESENTATION OF HORIZONTAL MOVEMENTS OF THE EARTH'S CRUST BY RESULTS OF GEODESIC MEASUREMENTS

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ABSTRACT: *The subject of the study is to present a modern model of local horizontal movements of the Earth's crust in a fault zone with appropriate accuracy and representativeness through the results of precise GNSS measurements on a geodynamic site to analysis and evaluation of modern local geodynamic processes occurring in fault zones.*

KEYWORDS: *fault zone, geodetic measurements, horizontal movements*

1. Introduction

Visual methods for interpreting the results of observations of horizontal movements of the earth's surface are primarily related to their clarity. In this way, the data are available for visual perception and understanding. Various methods are used to visualize geodynamic processes at present, with special attention paid to the balance between clarity and metricity of the image. The correlation of these properties is different, when using different visualization methods and this is determined by the choice of presentation method. The predominant role of clarity in the construction of visual models provides simple visual perception, geometric accuracy, practical significance, the possibility of its use in obtaining numerical solutions and results [1, 2, 3].

2. Experimental results and discussion

2.1. Results of repeated geodetic measurements.

The results were obtained from four consecutive cycles of precise geodetic measurements in the time between 27 - 29.10.2015, 27.04 - 05.05.2016, 28.05 - 01.06.2016 and 28.10 - 01.11.2016 year. The period between the first two cycles is six months, between the second and third is one month and between the third and fourth measurement cycle is five months. On 22.05.2016 an earthquake with a magnitude of M = 4.3 was registered according to the data of the Bulgarian

Academy of Sciences, and 12 minutes after the first quake, a second with magnitude M = 3.2 was registered. The results are shown in Table 1.

Table 1: Results of repeated geodetic measurements

			GEODETIC DATUM: IGb08 EPOCH: 2005.01.01 00:00:00
(N34) I measurement 27-29.10.2015 *y.*			
№ point	X (m)	Y (m)	Hel (m)
1	2	3	4
17	4634545.860	678328.979	345.118
18	4634650.542	678284.243	337.786
19	4634745.369	678390.891	344.509
20	4634535.948	678524.450	345.611
(N34) II measurement 27.04-05.05.2016 *y.*			
17	4634545.855	678328.978	345.152
18	4634650.536	678284.243	337.824
19	4634745.382	678390.885	344.539
20	4634535.962	678524.444	345.679
(N34) III measurement 28.05-01.06.2016 *y.*			
17	4634545.855	678328.994	345.135
18	4634650.527	678284.239	337.790
19	4634745.387	678390.957	344.440
20	4634535.973	678524.516	345.531
(N34) IV measurement 28.10-01.11.2016 *y.*			
17	4634545.858	678328.982	345.121
18	4634650.544	678284.252	337.802
19	4634745.368	678390.891	344.486
20	4634535.941	678524.431	345.637

2.2. Graphic representation of modern movements of the earth's crust.

The actual horizontal movements of the points and the area deformations for the finite elements are visualized by 3D graphs separately for each period between measurements. There are two spatial coordinates (x, y) and the third (t)

is time. The displacement vectors of the points are multiplied by a suitable coefficient. The visualizations of the following figures.

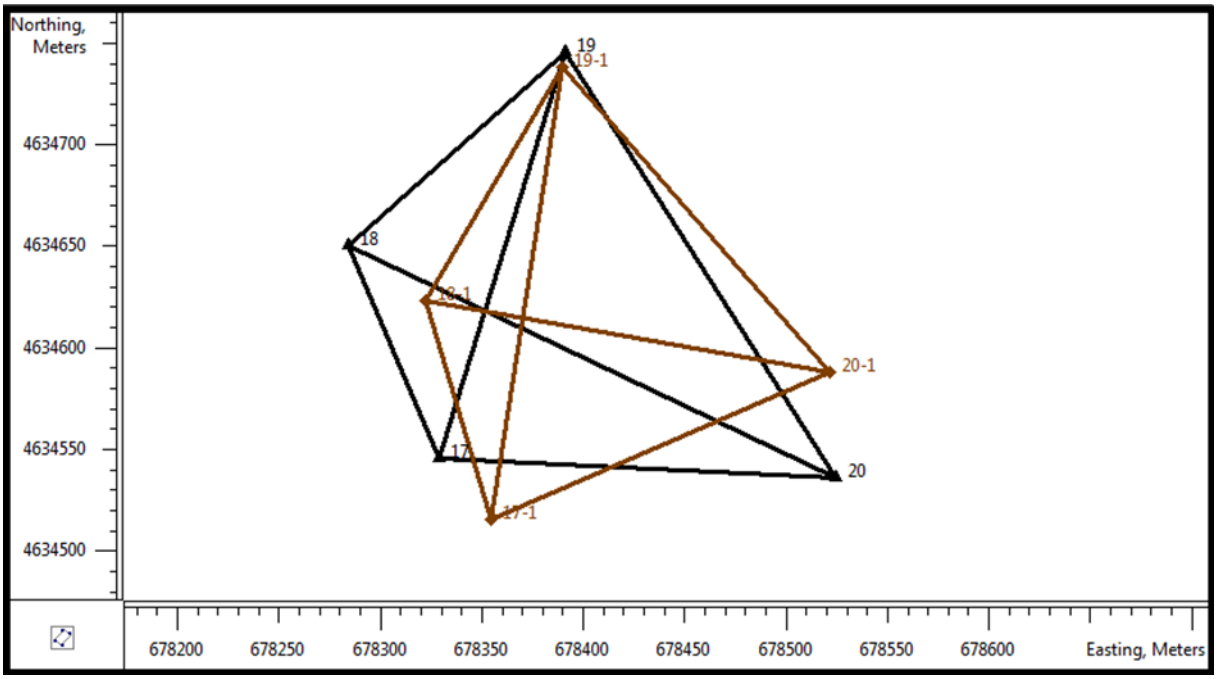

Fig.1. Deformations of the final elements of measurement 1-2

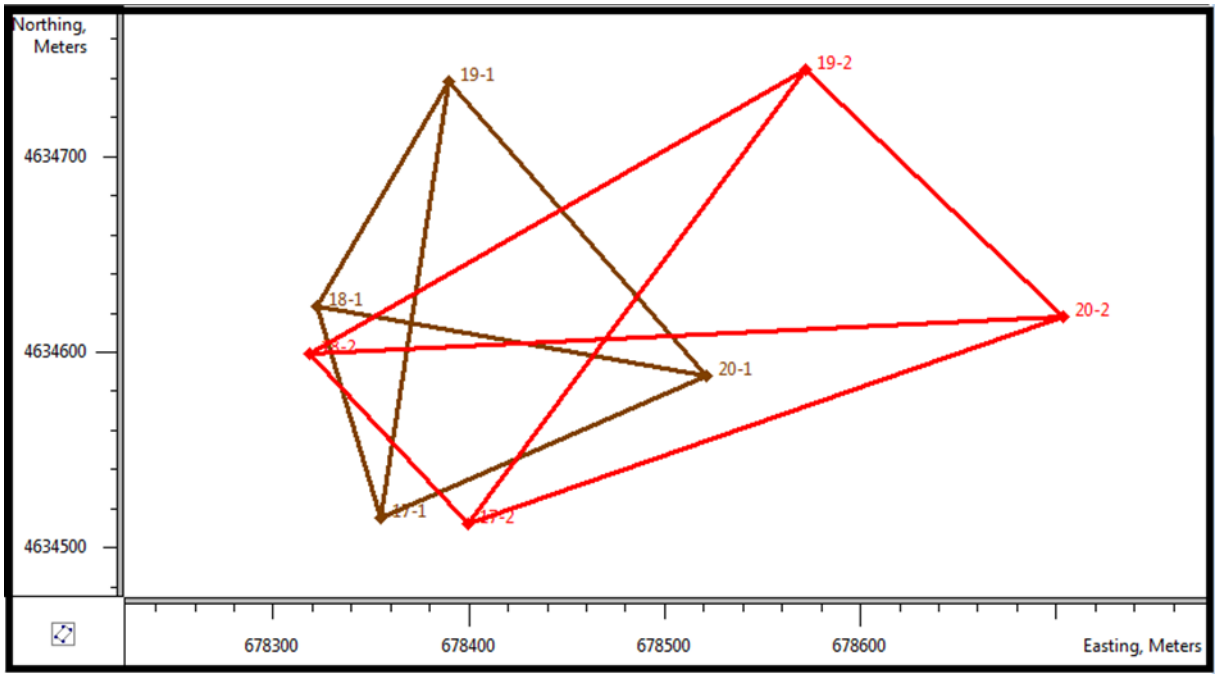

Fig.2. Deformations of the finite elements of measurement 2-3

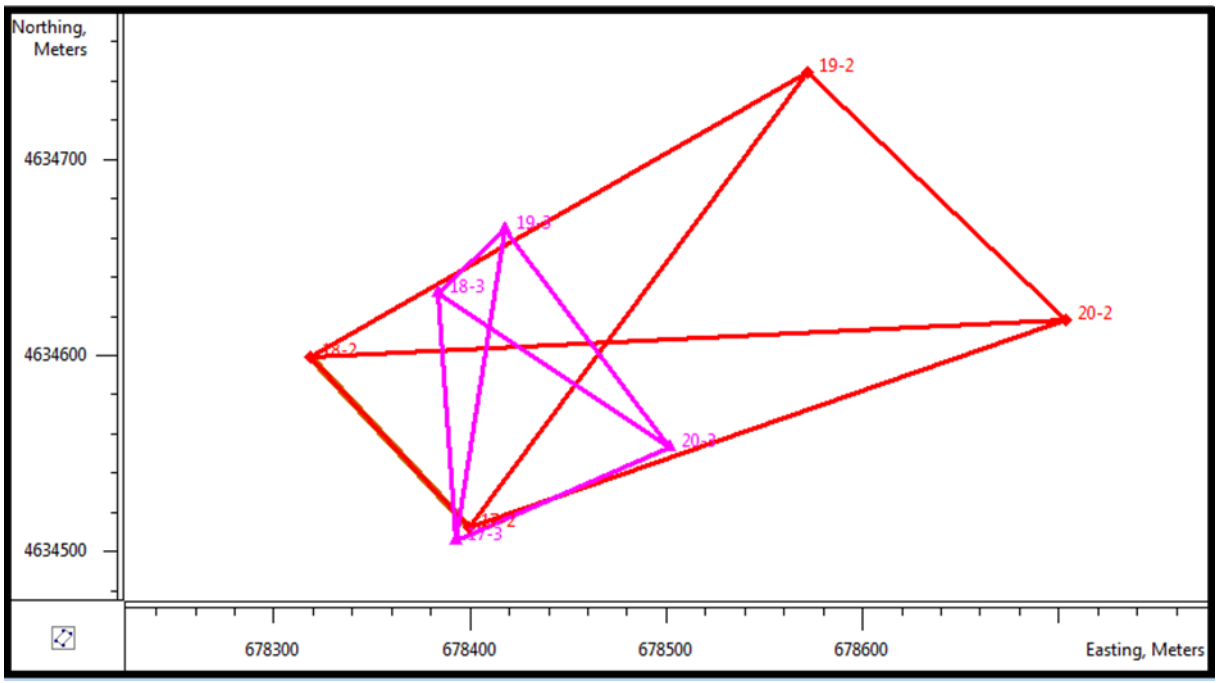

Fig.3. Deformations of the final elements from measurement 3-4

The analysis of the movements performed by the points shows that during an earthquake the accumulated stress due to the relative movements is released and they return to their original position.

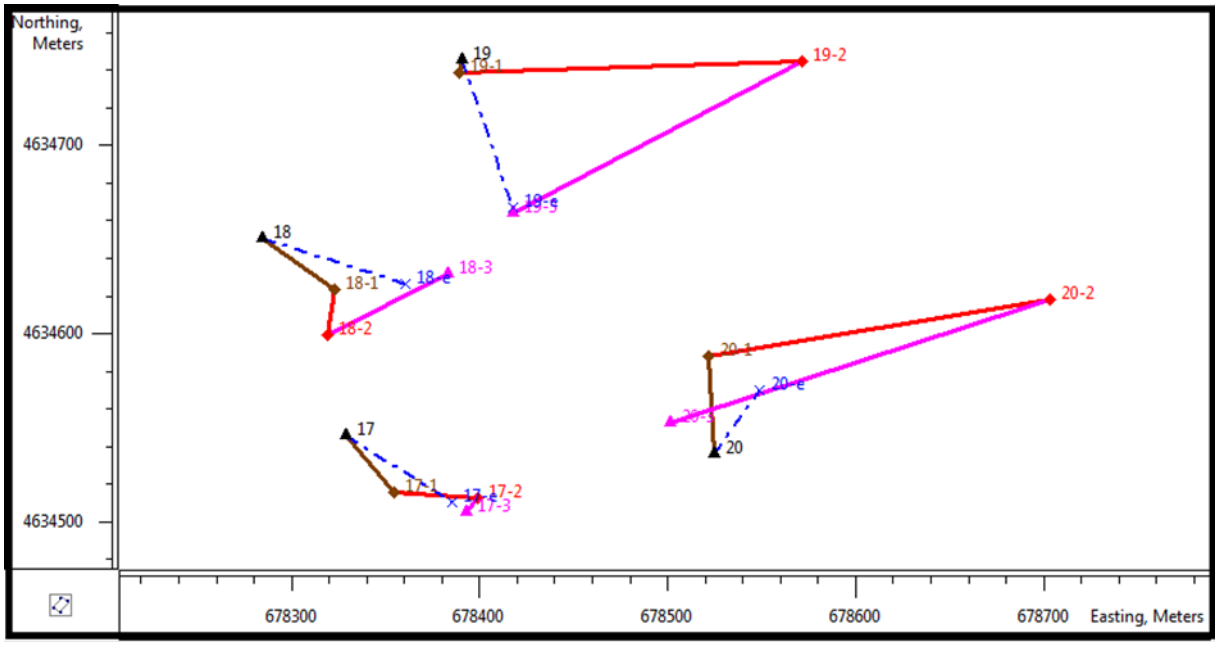

Fig.4. Vectors of point motion

The combined stage movement of all the measurement cycles is shown in Figure 4 represented by solid lines and the annual movement of the points of the calculated tectonic pattern of movements by dotted line.

3. Conclusion

The GNSS measurements made allow to build an up-to-date model of local horizontal movements for the research area. The manifested non-linearity in the behavior of local geodynamic processes determines the complexity of solving the problem of their study, as well as the study of natural and technical geodynamic objects of different scales. The conducted researches prove the existence of small blocks performing their own movements caused by local geodynamic processes, which have a continuous influence on the geodetic measurements and networks.

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