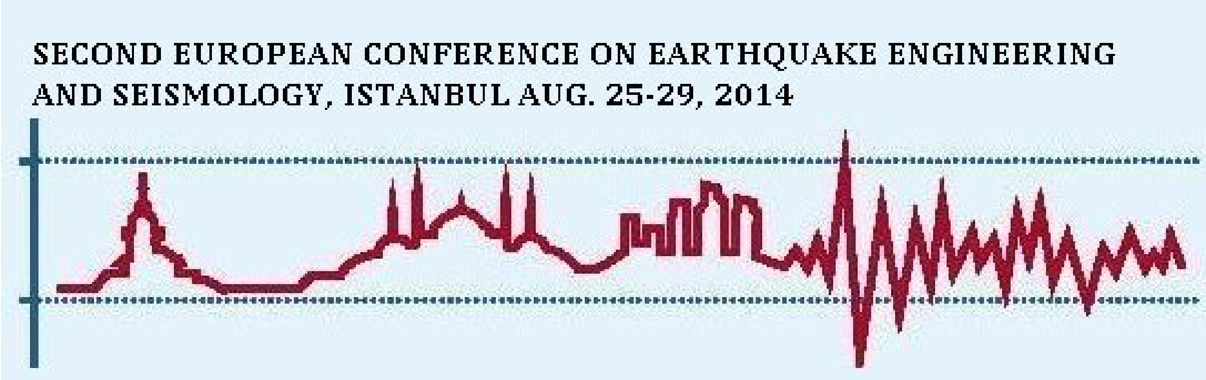

STUDY OF NEOTECTONIC AND EARTHQUAKE ENGINEERING PROCESSES IN THE CENTRAL PART OF EAST EUROPEAN (RUSSIAN) CRATON

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To identify the neotectonic and earthquake engineering processes in the Central Part of East European Craton (EEC), the combined approach is used. The results of visual and automated decoding of the LANDSAT satellite images are analyzed combined with the data of precision measurements for horizontal components of GPS station displacement. This approach allowed us to consider the neotectonic activity of geological structures and to distinguish the zones of higher earthquake engineering instability (Adushkin et al., 2014).

Application of the algorithms of LESSA program package (Lineament Extraction and Stripe Statistical Analysis) (Zlatopolsky, 1992) creates the possibility to decode the lineaments of different hierarchical levels and to determine the statistical parameters of space distribution of minor lineaments (density and characteristics of rose-diagrams). Minor lineaments are used for reconstructing major lineaments and elongation axes of rose-diagrams (the lineament forms). The lineament forms, presumably, reflect the structural-lithology, rheological and geophysical heterogeneity of the geological environment. The high-precision measurements of ground surface displacements are carried out using GPS technologies. The coordinates and velocities of GPS stations were estimated using the specialized GAMIT/GLOBK program package (Herring et al., 2010).

This study relies on the data from 12 GPS stations located in EEC and its framing regions. The daily high-accuracy estimates of the coordinated for all GPS stations were combined into the time series with a maximal length of about 14 years (January 1, 2000 to October 20, 2013) and a minimal length of 3 years. In this study, we constructed the space image based for the central part of EEC using the LESSA program package and the data on the deep structure of the Earth's crust. We determined the morphostructural plan and estimated the geodynamical and earthquake engineering conditions within this territory by analyzing this map (Fig. 1). The deep fracture zones and aulacogens (Pachelma, Moscow, Pripyat-Donetsk aulacogens, etc.) are detected in morphostructural pattern through the sedimentary cover and connected with regional geological history (Adushkin et al., 2014). The observation points are located in different structural zones and blocks. In the central part of EEC, 3 GPS stations are installed near the towns (MOBN station in Obninsk, ZWEN in Zvenigorod, and MDVO in Mendeleevo), and 8 GPS stations are located along boundary of ECC and adjacent territory

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(Fig. 2). 2 GPS stations (ZWEN and MDVO) are related to the same morphostructural block, which is bounded by the extended lineaments.

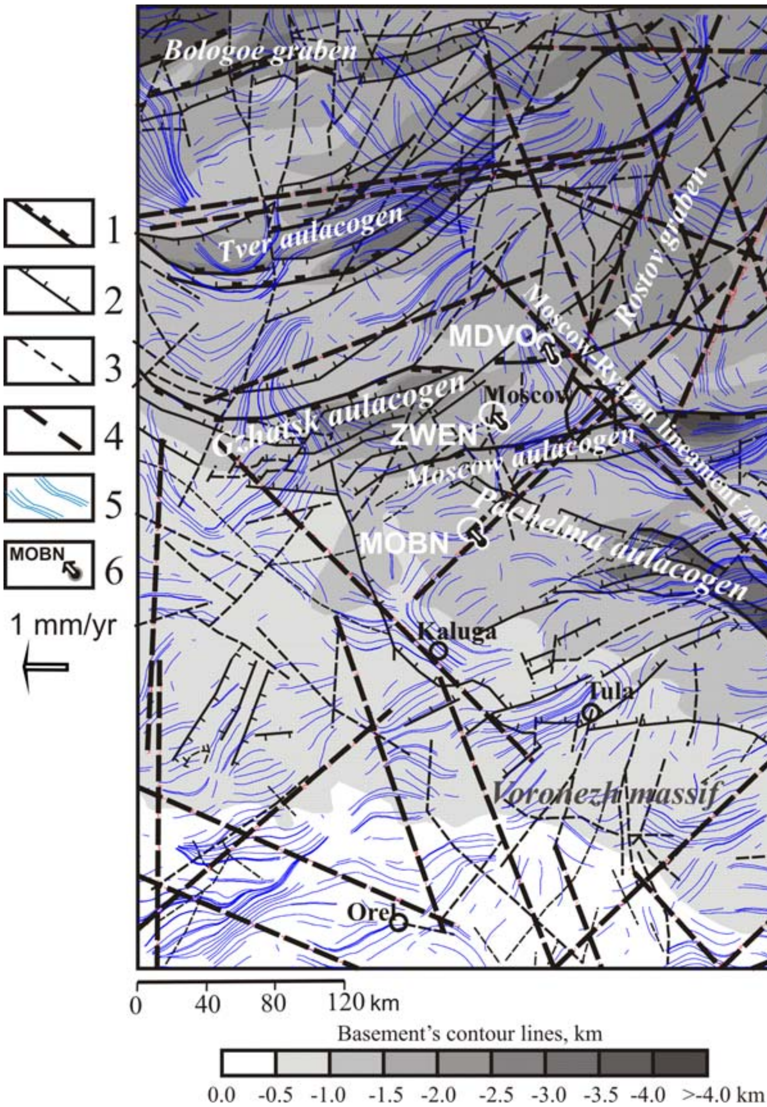

Figure 1. The space image based of the central part of EEC: (1) regional faults; (2) secondary faults; (3) faults of different orders; (4) extended lineaments; (5) lineament forms; (6) GPS stations (MDVO, Mendeleevo; MOBN, Obninsk; ZWEN, Zvenigorod). Here and in Fig. 2, the arrow represents the direction and rate of horizontal displacement relative to the Eurasian lithospheric plate, mm per annum; the velocities are indicated together with the 1-sigma error ellipses)

During 2002-2013, the MDVO, ZWEN, and MOBN stations are characterized horizontal displacement in the north-west direction and corresponded modern activity and earthquake engineering of EEC. The geodynamical activity periphery and adjacent territories of EEC (Baltic Shield, Ural orogen, Pripyat-Donetsk aulacogen, and Scythian Plate) are detected from the displacements of GPS stations located within these structures (Fig. 2). At the Lovozero observation point (LOVJ), horizontal northward displacement with a velocity of 0.7 mm per annum is detected. According to the data from Svetloe GPS station (SVTL), which is located in the junction zone of Baltic Shield and Russian Plate, the southward displacement at a rate of 1.0 mm per annum is revealed. The fact that LOVJ and SVTL GPS points are moving in different directions can be associated with the dying-out postglacial isostatic uplift of the Baltic Shield. Horizontal displacement in the northward direction with a velocity of 0.4 mm per annum is revealed for the Arti GPS station (ARTU) located within the Cis-Ural foredeep. The Poltava (POLV) and Kharkov (KHAR) GPS stations are located within the Pripyat-Donetsk aulacogen. The northwestward motion at POLV with a rate of 1.1 mm per annum and southeastward motion at KHAR a 0.3 mm per annum are due to the strike-slip displacement along the boundary faults limiting the aulacogen.

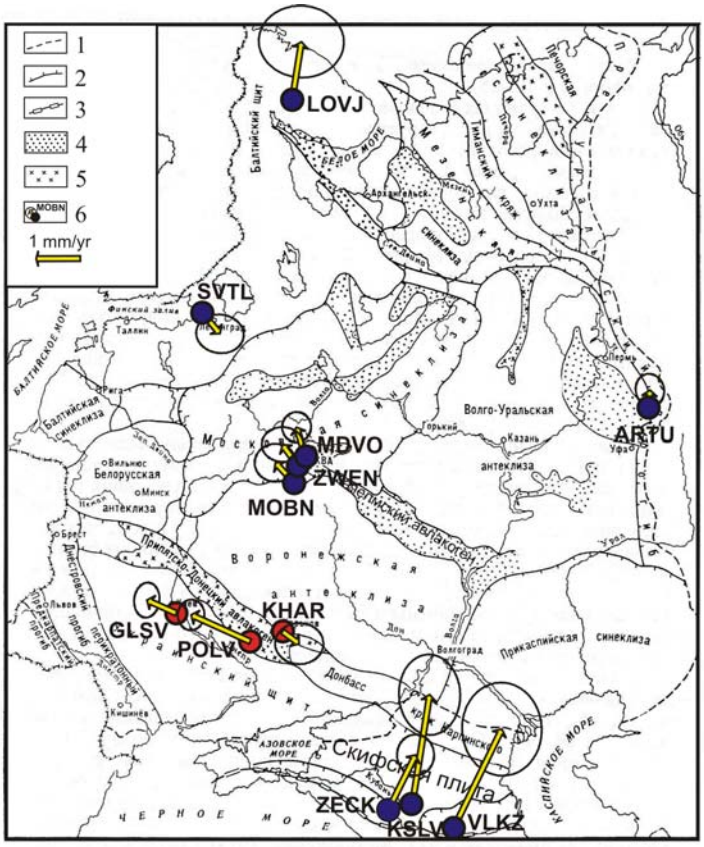

Figure 2. The scheme of tectonic zoning for EEC (Yudakhin et al., 2003) superimposed by the data on the horizontal displacement velocities of GPS stations: (1) the boundary of EEC; (2) the boundary of the main structures; (3) the southern boundary of the Scythian Plate; (4) Precambrian aulacogens; (5) Paleozoic aulacogens; (6) GPS stations: ARTU, Arti; GLSV – Kiev; KHAR, Kharkov; KSLV, Kislovodsk; LOVJ, Lovozero; MDVO, Mendeleevo; MOBN, Obninsk; POLV, Poltava; SVTL, Svetloe; ZECK, Zelenchukskaya; ZWEN, Zvenigorod; VLKZ, Vladikavkaz

The region of the young Scythian Plate adjacent to EEC is geodynamically most active. According to Zelenchukskaya (ZECK), Kislovodsk (KSLV), and Vladikavkaz (VLKZ) GPS stations, along the Scythian Plate that frames EEC in the south, the rate of displacements increases from 0.8 to 2.9 mm per annum, and the direction of motion changes from the north-northeastward to northeastward. The general pattern of the direction of motions for the structural units of EEC and its framing suggest predominance of lateral pressure from the south and southwest from the Scythian Plate, which is transformed in some geodynamical regions.

Generally, the solution derived from GPS data demonstrates good agreement in the motions at the stations located in the regions with the similar mechanism of deformation.

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