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Gravity Gradients in Latvia

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Abstract. **This article discusses one of the most important geophysical factors, which produces an impact on the demographic processes and reflects the nature of variability in the anomalous gravity field intensity in space. The article characterises the horizontal gravity gradients, which vary from 0,2 to 2,5 mGal/km. At the end, the article gives an ecodemographic evaluation of the territory of Latvia by the gradience of the anomalous gravitational field.**

Keywords**: Horizontal gravity gradient, gravity scale, ecodemographic evaluation of territory by gravitational gradientce.**

The term "gradient" in physics and other sciences denotes the fastest change in the direction of the physical field size (or some other size, such as pressure, temperature, etc.) in space moving from one point to another. In case of geophysics, gravity gradient is a quantity that characterizes one of the gravitational field elements. This shows speed of the gravity changes in two directions - vertical and horizontal. Etves is taken as a measuring unit of this gradient (1 etves = 1 mGal/10 km), it is named after a Hungarian scientist Lorand Etves.

I. Normal and Anomalous Gradients, Their Effect on the Natural Objects

There are normal and anomalous gravity gradients distinguished.

Normal gradients (vertical and horizontal) correspond to the ideal Earth model with the correct shape and simple, evenly distributed, density mass. Most of them are a normal vertical gravity gradient of the Earth, which, on average, for the entire planet is equal to 3086 etves [3].

Anomalous gravity gradients, unlike the normal ones, characterize anomalous component of the Earth gravity field. Gravitational anomaly appears because density of the Earth is not even and it has irregular form. Anomalous gradients are determined by observed gravity anomalies. These (anomalous gradients) allow judging on the irregularity of the density in the upper Earth crust, therefore, they are used, mainly, to solve geological tasks, but can be used, as shown below, in biogeophysics too.

Anomalous gradient values (vertical and horizontal) achieve tens in plain areas, and hundreds etves in mountainous areas [3].

In practice, only horizontal gravity gradients are used in gravimetric and biogeophysical studies. Their values are measured either by instruments (gravitational gradientometer and variometer), or by calculations. Works at local level are carried out using instruments, but works at regional level are carried out using calculations, our biogeophysical studies belong to the latter instance.

Horizontal gravity gradients are the lateral index of changes in anomalous gravitational field, which reflects the nature of the border between the anomalies (gradual or sharp). Just as the gravity anomalies are caused by deep geological bodies of different density, so the horizontal gradients fix the nature of the border not only between the anomalies, but also the disparities between the irregular densities. Moreover, the straight marked gradient areas often reflect the disjunctive nature in interrelation between the geological bodies and are interpreted as tectonic fractures of the Earth crust. As it is known, spatial fractures are closely related to so-called geopathogenic areas, which negatively affect the inhabited environment and population health. According to the opinion of biogeophysics scientist A. Dubrov, fracture zones are represented by the increased risk, they provoke and accelerate incidence of a disease with a wide range of aetiology [2].

Indeed, the gravity gradients in biogeophysics are given a great importance as places of human exposure to dangerous geophysical factors. As the longstanding experience and observations of geologists, geophysical, medical practitioners and biophysics show, continuous stay of people in gradient geopathogenic areas causes different oncologic diseases [2].

Individual authors consider gravity gradients as boundary areas of gravity anomalies, which affect the living and non-living natural objects [1]. They note, for example, the fact of orientation disorder in whales, when they deviate from the gravity gradient zone. Gravity gradient areas, according to the authors' data, are clearly reflected in vegetation structure, especially in arctic and subarctic regions. This is explained by the fact that temperature anomalies are fit to the gradient zones, promoting better growth of tundra plants. Far to the south in the forest regions, the gravity controls the linear - oriented forest strips with well-developed vegetation sections alternated with depressed plants sections in those.

II. Characteristics of Horizontal Gravity Gradients in Latvia

Horizontal gravity gradients are a component of the Latvian anomalous gravitational field, represented by different anomalies, tension, size and morphology. Gradients gravimetric maps are displayed as isoanomalous consolidation or rarefaction areas, usually at the point of transition from one anomaly to another. Consolidation degree shows change in gravitational field consolidation speed in horizontal direction perpendicular to isoanomalous surface. The larger isoanomalous consolidation is, the higher the gradient values are.

Horizontal gravity gradient values within the boundary of Latvia are determined by calculations as a difference between gravitation field consolidation values at two points divided by the distance. Miligals per kilometre (mGal/km) are measured.

Our calculations are based on gravity maps of the USSR M1: 200 000 (A. Faitelson, A. Aleksashina et al, 1965-1980), within the framework of development of the scientific

research topic: "Effect of geodesic factors on demographic processes and human habitat (RTU, 2010).

The calculation results show that the horizontal gravity gradients in the territory of Latvia vary in the range from 0.2 to 2.5 mGal / km. According to the gradient value, there are three groups:

a) low gradient (Gg>1mGal/km);

b) average gradient (Gg=1,0-1,5 mGal/km);

c) high gradient (Gg<1,5 mGal/km).

Low gradients characterize the light flowing and gradual mass distribution in the area. High gradients reflect sharp uneven changes of gravity, which are generally attached to the deep uneven mass limits. They often show, as noted above, the disjunctive origin borders between density masses.

Horizontal gravity gradients, consisting of long, stretched and small area zones (l> 3d), are considered among the gravity step category. In contrast, gradients, which consists of isometric or wide, slightly stretched zones (l <3D), correspond to gravity gradient plane category. Steps are usually characterized by high and medium gradient figures (Gg> 1.0 mGal/km), but the planes – by low figures (Gg <1.0 mGal / km, on average - less than 0.5 mGal/km). Steps by their length are divided into regional (l> 100 km) and local (l <100 km).

Gravity steps usually are associated with intense anomaly edges, surrounded by the wide epicentral uplift. In narrow uplifts, step sides virtually join along the anomaly axis line. But, big anomalies in wide and large uplifts are separated in low-gradient areas, which limits the step sides.

The wide gravity gradient area is associated with a large abnormal structure with reduced voltage level of the gravitational field, which, in general, consists of local distribution-related gravity anomalies. Gradient values within planes and steps are not constant. They vary from place to place, forming local gradient areas within steps and planes. These areas reflect lateral local fluctuations of the gravity gradients.

III. Spatial Distribution of Horizontal Gravity Gradient

Distribution of horizontal gravity gradients and their value in the Latvian territory is shown on the map (Figure 1). The map shows that the horizontal gravity gradients as gravity steps and planes as well as their values are unevenly distributed in different parts of Latvia.

Horizontal gravity gradients in the Western Latvia, in its northern part, so-called the Northern Kurzeme gravity anomalous region, compared with the Southern part (Southern Kurzeme gravity anomalous region) have different gradients.

Gravity gradients in the Northern Kurzeme gravity anomalous area correspond to a low gradient group (Gg less than 1.0 mGal/km). There is no gravity stem in this area. Multi-directional local gravity gradients are combined in a single wide gravity gradient area (I zone, see Figure 1) with gradient values from 0.2 mGal/km to 1.0 mGal/km.

Horizontal gravity gradients in the Southern Kurzeme are made of regionally distributed gravity steps, which, mostly, are directed in subhorizontal direction, and alternated with gravity gradient planes. Gradient values at the step borders vary from 0.9 to 2.4 mGal/km, but within the plane border - from 0.4 to 0.7 mGal/km. The largest of the gravity steps is the Western part of Pāvilsosta - Valmiera superregional step (1), which at a 150-km-long run Pāvilsosta – Vilgale Lake - Tukums separates the Southern Kurzeme from gravity anomalous area (Figure 1).

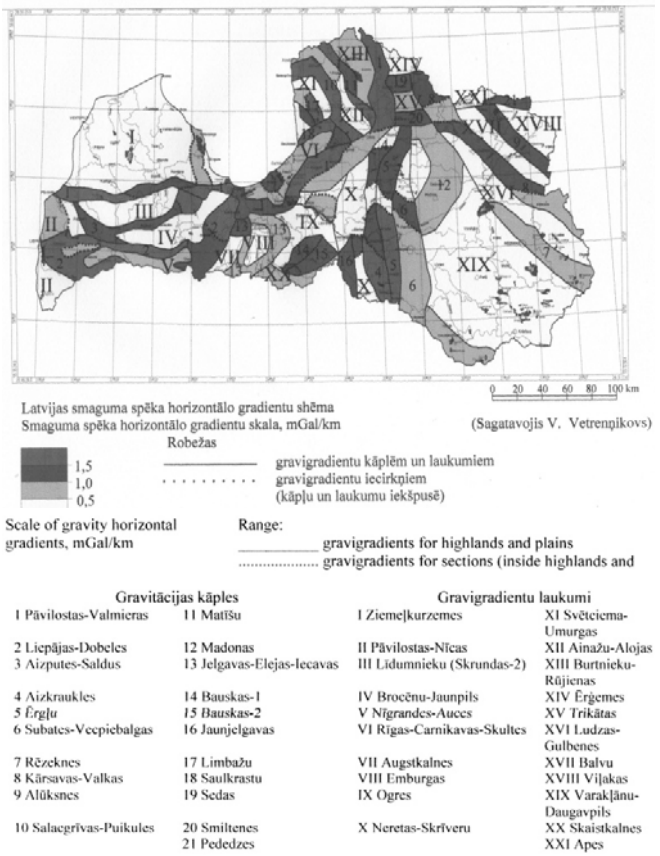


Fig. 1. Chart of gravitation horizontal gradients in Latvia. (Prepared by V.Vetreņņikovs).

Central Latvia (between 23°30′ and 26°00′ meridian) is characterized by gravity gradients, which are mainly made of gravity steps with their subordinated gravity gradient areas. Distribution and direction of steps, by their gradient values, differ in various parts of Central Latvia, in particular: in the North part (the Riga - Rūjiena gravity anomalous area) and Southern (the Jelgava - Eagle gravity anomalous area) parts.

There are gravity steps concentrated in the Riga - Rūjiena gravity anomalous area with the highest gradient values. The regional steps of more than 100 km in length are mostly prevailing (1,10,11 - Figure 1). Steps alternate with gravity gradient planes (XIV, XV, XIII, VI). Gradient values in steps are from 0.9 to 2.5 mGal/km, in planes - from 0.2 to 0.8 mGal/km. The biggest is the Pāvilosta - Valmiera superregional Eastern step (1), surrounded by the Riga - Rūjiena gravity anomalous area for 210 km: Jurmala - Olaine - Ķekava - Vangazhi - Cēsis - Valmiera - Rujiena (see Figure 1). This step runs with zero isoanomaly, it covers both negative and positive parts of the field. The highest gravity gradient values are observed in Vangaži (2.4 mGal/km) and Valmiera (2.5 mGal/km).

Western and eastern parts with different gradient zone morphology in the gravity anomalous area Jelgava – Eagle are distinguished:

Western part of this area is characterized by the developed, not long (less than 100 km), local, multi-oriented steps (14, 15, 13) and planes (IX, VIII, VII, XXII), with the relevant gradient figures from 0.7 to 1.5 and 0.2 to 0.8 mGal / km.

Eastern part of the Jelgava - Eagle gravity anomalous area part is characterized mainly by long (more than 100 km) regional steps, which have linear form (4, 5, 6, 16,). These make the meridional-directed gradient system, where steps alternate between themselves and their subordinate gravity gradient areas (X). The Eagle step is the longest (5), it stretches for 145 km in the meridional direction from the Southern border of the country to the Palsa River upstream. Gradient values vary from 0.9 to 1.8 mGal/km.

Eastern Latvia according to gravity field gradientity is divided into Southern (Madona - Aluksne gravity anomalous area) and Northern (Ape - Valmiera gravity anomalous area) parts.

Horizontal gravity gradients of Madona - Aluksne gravity anomalous area are represented by linear regional steps directed to the North-West (9,8,7) and gravity gradient areas stretched in the same direction (XX XIX, XVIII) intermitting system. Horizontal gradient values vary from 0.2 to 0.3 mGal / km (planes) to 0.6 to 1.3 mGal / km (step). The Kārsava - Valka gravitational step is the longest (8), it stretches for 190 km in length, and consists of four gradient units with the gradient values 0.6 and 1.2 mGal/km.

Gravity anomalous area Apes - Valmiera is characterized by horizontal gravity gradients, which is made by subhorisontally directed local gravity steps (19, 20, 21) and gravity gradient areas (XV, XXI).

South-Eastern Latvia is represented by the Varaklani - Daugavpils gravity anomalous territory. This territory is characterized by low gravity gradients. There is no gravity step within it; in general, it belongs to the plane gravity gradient category. Horizontal gravity gradient values in the territory mostly are equal to 0.2 mGal/km, reaching 0.6 mGal/km in the area to the Southwest from Daugavpils.

Thus, the foregoing spatial distribution of the horizontal gradients in the Latvian territory allows identifying certain regularities. In particular: high values of horizontal gravity gradient (Gg> 1.0 mGal / km) are mainly associated with Riga - Rūjiena, Southern Kurzeme and the Jelgava - Eagle (Eastern part) gravity anomalous territory. Most of all, low values of the horizontal gravity gradient (Gg <1.0 mGal / km), in general, are in the South-Eastern part of Latvia (the Varakļani - Daugavpils gravity anomalous territory), Western part of Latvia (the Northern Kurzeme gravity anomalous territory), as well as the Eastern part of Latvia (the Madona - Aluksne gravity anomalous territory).

IV. Average Gradientity Levels of the Anomalous Gravity Field

The moderate-speed changes in horizontal gravity anomalies in the voltage direction are used as AS gradientity levels of the gravitational field, special attention is paid to certain anomalies within the structure or the administrative-territorial unit. Gradientity level is determined in order to facilitate the use of gravity gradient comparing territories to determine their impact on demographic figures.

V. Calculation of Average Gradientity Level of the Anomalous Gravity Field

Calculated by the average weighted method according to the formula:

$$Gav.vid = \frac{S1 \cdot Gg1 + S2 \cdot Gg2 + Sn \cdot Ggn}{S1 + S2 + ...Sn} \quad (1)$$

Ggr.vid. – average weighted horizontal gradient of territory;
S1+S2+...Sn – areas of the territory with equal gradients;
Gg1+Gg2+...Ggn – individual gradient values in the same territories;
n – quantity of areas and individual gradient values.

In other words, the average horizontal gravity gradient values in one or another territory are equal to sum of the territories of the regions with the same gradients multiplied by individual gradients of the territories and divided by the total area of the territory.

According to calculations, the following figures represent average gradientity levels of anomalous structure of the gravity field and values in Latvian municipalities (Table 1). Calculations in the table show that the average weighted horizontal gravity gradients in municipalities vary from 0.2 mGal / km (Preili) to 1.48 mGal/km (Valmiera Region). The highest average weighted gravity gradients (Ggvid.> 1.0 mGal/km) are typical for the following regions: Dobele, Liepaja, Limbaži, Riga, Valka, Valmiera, but lower ones (Ggvid. <1.0 mGal/km) - Daugavpils Krāslava, Ludza, Preiļu, Rezekne, Ventspils.

Regions are correlated according to average gradient value and field mark as depicted in the chart (Figure 2). It is seen on the chart that according to very high gravity levels (Ggvid.> 1.0 mGal / km) within the positive field, the following regions correlate between themselves Dobele, Liepaja and Valka, but within negative field - Limbaži, Riga and Valmiera regions. The following regions correlate between themselves by low gradientity averages (Ggvid. <1.0 mGal/km):

within the positive field - Aizkraukle (Northern part), Aluksne, Balvi (Northern part), Cēsis (South-Eastern part), Daugavpils, Gulbene, Jēkabpils (Eastern part), Jelgava, Krāslava (Western part), Kuldiga (Southern part) Madona, Ogre, Preiļi, Rezekne (South - Western part), Saldus, Tukums (Southern part);

within the negative field - Aizkraukle (Southern part) Balvi (Southern part), Cēsis (North - Western part), Jekabpils (Western part), Krāslava (Eastern part), Kuldiga (Northern part), Ludza, Rezekne (North - Eastern part), Talsi, Tukums (Northern part), Ventspils.

TABLE 1

GRAVIANOMALOUS STRUCTURES AND AVERAGE HORIZONTAL GRADIENTS IN THE LATVIAN MUNICIPALITIES

Gravianomalous structures	Average gravity gradients, mGal/km	No.	Municipalities	Average gravity gradients, mGal/km	No.	Municipalities	Average gravity gradients, mGal/km
Western Latvia:	0,63	1.	Aizkraukle	0,90	14.	Limbaži	1,24
Ziemeļkurzeme anomalous region	0,30	2.	Alūksne	0,67	15.	Ludza	0,40
Dienvidkurzeme anomalous region	0,96	3.	Balvi	0,63	16.	Madona	0,68
Central Latvia:	1,10	4.	Bauska	0,81	17.	Ogre	0,57
Anomalous region Rīga – Rūjiena	1,30	5.	Cēsis	0,99	18.	Preiļi	0,20
Anomalous region Jelgava – Ērgļi	0,80	6.	Daugavpils	0,40	19.	Rēzekne	0,30
Eastern Latvia:	0,73	7.	Dobele	1,20	20.	Rīga	1,12
Anomalous region Madona – Alūksne	0,67	8.	Gulbene	0,69	21.	Saldus	0,78
Anomalous region Ape – Valmiera	0,90	9.	Jēkabpils	0,76	22.	Talsi	0,23
South-Eastern Latvia:	0,30	10.	Jelgava	0,78	23.	Tukuma	0,94
Anomalous region Varakļāni – Daugavpils	0,30	11.	Krāslava	0,28	24.	Valka	1,05
Latvia, in general	0,74	12.	Kuldīga	0,79	25.	Valmiera	1,48
		13.	Liepāja	1,09	26.	Ventspils	0,33

VI. ECO-DEMOGRAPHIC EVALUATION OF THE TERRITORY OF LATVIA BY ANOMALOUS GRAVITATIONAL FIELD GRADIENTITY

Horizontal gravity gradients are a key element of the anomalous gravity field and belong to permanently functioning ecologically physical factors that are naturally closely related to the population. Their impact on humans, as well as the Earth gravity in general, is all-inclusive, but versatile in different places depending on the gradient values.

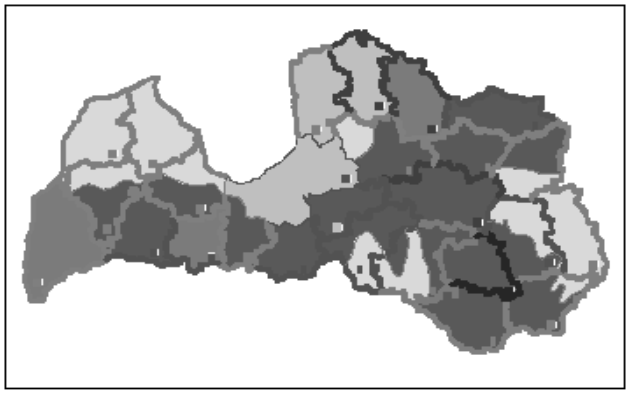
Ecological demographics of the territory by anomalous gravity field gradientity has not been practically studied in Latvia. Spatial analysis of the above-mentioned gravity horizontal gradient distribution (see Table 1 and Figure 1) allows to come closer to its solution.

Chart of ecological demographics of the Latvian territory (Figure 3) shows the anomalous gravitational field gradientity. It, in accordance with the gradient values and criteria for gravitational field marks, distinguishes three eco-demographic groups: a) the territories friendly for human habitation (Gg <1.0 mGal/km – within the positive gravity field), b) the territories adverse for human habitation (Gg < 1.0 mGal / km – within the negative gravity field, Gg = 1.0 to 1.5 mGal / km – within the positive and negative gravity field), c) the territories most harmful for human habitation (Gg> 1.5 mGal / km – within the positive and negative gravity field).

Such gradation of the territories to a certain extent was based on the study results in the neighbouring country - Lithuania [4]. A significant fact was stated, namely: inverse correlation of gravity field gradientity with certain diseases (tuberculosis), as well as crime rate. The lower gravity gradients are the higher the registered illness incidence is. Such regularity also applies to Latvia, mainly in the territories with negative gravity field. Territories with positive increased gradientity of the gravity field (in Lithuania and Latvia by analogy) have positive correlation with the incidence of diseases, particularly, upon increase of the gradient values, disease incidence increases, inter alia levels of infection (especially among women) and respiratory disease incidence.

Thus, taking into account the regularities in Lithuania, we can assume that negative effect on the Latvian population may be produced by low horizontal gradients of less than 1.0 mGal/km within the negative gravitational field limits. Unlike the low gradients within the negative field areas, territories with low gradients (less than 1.0 mGal/km) within the positive field are human-friendly. By contrast, high gradients from 1.0 to 1.5 mGal/km, and in particular more than 1.5 mGal/km can have a negative impact within both positive and negative gravitational fields.

In accordance with these criteria, an eco-demographic evaluation of the field gradientity in the gravity anomalous structures and Latvian administrative districts, characterized by the average gradient values, has been performed (see Table 1 and Figure 2.).

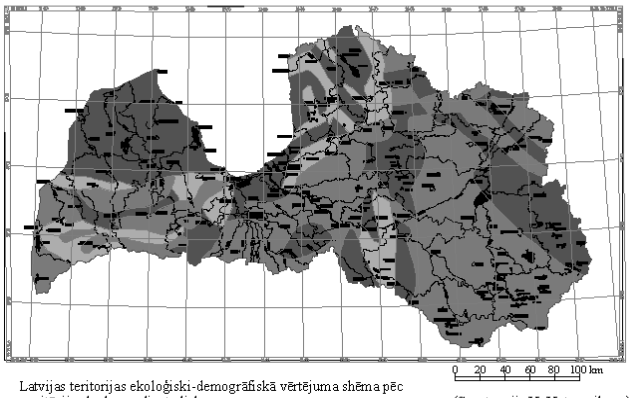


---------- Smaguma spēka pozitīvās un negatīvās robežas rajonu iekšpusē

Rajonu vidējo gradientu skala mGal/km	Smaguma spēka anomālā lauka zīme	
	Administratīvie rajoni, to numurs	
	+	-
1ρ	Dobeles (7), Liepājas (13), Valkas (24)	Limbažu (14), Rīgas (20), Valmieras (25)
	Aizkraukles-dienvidu daļa (1), Balvu-dienvidu daļa (3), Cēsu-ziemeļu daļa (5), Jēkabpils-rietumu daļa (9), Krāslavas-austrumu daļa (11) Kuldīgas-ziemeļu daļa (12), Ludzas (15), Rēzeknes-ziemeļaustrumu daļa (19), Talsu (22), Tukuma-ziemeļu daļa (23), Ventspils (26)	

----- Positive and Negative Limits of Gravity Field inside the Regions.

Fig. 2. Correlation Chart of Latvian Administrative Regions by Anomalous Gravity Gradientity (Prepared by V.Vetreņņikovs).



Latvijas teritorijas ekoloģiski-demogrāfiskā vērtējuma shēma pēc gravitācijas lauka gradienta lieluma (Sagatavojis V. Vetreņņikovs)

1 - Labvēlīgās teritorijas iedzīvotāju izvietošanai (Gg < 1,0 mGal/km)-pozitīvā, 2 - Nelabvēlīgās teritorijas iedzīvotāju izvietošanai (Gg=1,0-1,5mGal/km)-negatīvā lauka robežās; 3 - Sevišķi nelabvēlīgās teritorijas iedzīvotāju izvietošanai (Gg>1,5mGal/km).

1 - territories favourable for human habitation (Gg<1,0 mGal/km- within positive field limits)

2 – territories unfavourable for human habitation (Gg=1,0-1,5 mGal/km; Gg>1,0 mGal/km – within negative field limits);

3 – territories favourable for human habitation (Gg>1,5 mGal/km).

Fig.3. Ecologic and Demographic Assessment of Latvian Territory by Anomalous Gravitation Field Gradientity (Prepared by V.Vetreņņikovs).

5 gravity anomalous structures belong to the group of the territories friendly to people to live within the positive gravitational field with low average weighted gradient values (Ggvid. <1.0 mGal / km): Varaklani - Daugavpils, Southern Kurzeme, Madona- Aluksne, Ape - Valmiera, Jelgava- Eagle, and most of the administrative districts: Aizkraukle (Northern part), Aluksne, Balvi (Northern part), Bauska, Cēsis (South-Eastern part), Daugavpils, Gulbene, Jēkabpils (Eastern part), Jelgava, Krāslava (Western part), Kuldiga (Southern part), Madona, Ogre, Preiļi, Rezekne (South-Western part), Saldus, Tukums (Southern part).

2 gravity anomalous areas belong to the territories adverse for human habitation, according to average weighted value of the field gradient (Ggvid. <1.0 mGal-kilometre - within a negative field, and (Ggvid.> 1.0 mGal-kilometre - within a positive and negative field): Northern Kurzeme and Riga – Rūjiena, and some territories of the administrative regions: Aizkraukle (Southern part) Balvi (Southern part), Cēsis (North-Western part), Dobele, Jēkabpils (Western part), Krāslava (Eastern part), Kuldiga (Northern part), Liepaja, Limbaži, Ludza, Rezekne (North-Eastern part), Riga, Talsi, Tukums (Northern part), Valka, Valmiera, Ventspils.

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Vladimirs Vetreņņikovs. Smaguma spēka gradienti Latvijā
Gravitācijas gradienti ir nozīmīgi ekoloģiski ģeofizikālie parametri, kas atspoguļo anomālā gravitācijas lauka sprieguma izmaiņas izplatījumā.
Rakstā sniegti smaguma spēka horizontālo gradientu raksturojumi, kuru lielumi Latvijas teritorijā mainās no 0.2 līdz 2.5 mGal/km. Starp gradientiem izdalītas un raksturotas gravitācijas kāples un gravigradientu laukumi. Aprakstīts to izvietojums izplatījumā un pievienota Latvijas teritorijas smaguma spēku horizontālo gradientu izvietojuma shēma. Parādītas gradientu izvietojuma likumsakarības Latvijas teritorijas dažādās daļās: Rietumu, Centrālajā un Austrumu. Izskaitļoti gravitācijas lauka gradientātes vidējie līmeņi atsevišķām anomālām struktūrām un administratīvajiem rajoniem, pamatojoties uz tiem veikta rajonu korelācija un izstrādāta šā parametra korelācijas shēma.

Noslēguma sadaļā sniegts ekoloģiski demogrāfiskais Latvijas teritorijas novērtējums pēc anomālā gravitācijas lauka gradientātes, kas arī attēlota shēmā. Pēc gradientu lielumu un gravitācijas lauka zīmes kritērijiem izdalītas trīs ekoloģiski ģeofizikālās grupas gradientu teritorijas: a) labvēlīgas iedzīvotāju dzīvošanai (Gq<1.0 mGal/km – smaguma spēka pozitīva lauka robežās); b) nelabvēlīgas (Gq<1.0 mGal/km - smaguma spēka negatīva lauka robežās un Gq=1.0–1.5 mGal/km - smaguma spēka negatīva uu pozitīva lauka robežās); c) visnelabvēlīgākās (Gq>1.5 mGal/km – pozitīva un negatīva lauka robežās). Pēc gradientu vidējiem lielumiem Latvijas administratīvie rajoni pārsvarā atbilst teritorijas pirmajai un otrajai grupai. Vairums rajonu pieder pie pirmās (labvēlīgās) grupas, bet pie otrās (nelabvēlīgās) grupas – Dobeles, Limbažu, Valmieras, Rīgas, Liepājas.

Sagatavotos materiālus un kartes var izmantot teritorijas plānošanas procesā. Ņemot tos vērā, ir iespējams noteikt gravigradienta zonas iedarbību uz iedzīvotājiem, un to ietekmi uz demogrāfiskiem rādītājiem.

Владимир Ветренников. Градиенты силы тяжести Латвии

Гравитационные градиенты являются важным эколого- геофизическим параметром, отражающим характер изменчивости напряженности аномального гравитационного поля в пространстве.

В статье дается характеристика горизонтальных градиентов силы тяжести величины, которых на территории Латвии изменяются от 0,2 до 2,5 мГал/км. Среди градиентных зон выделяются и характеризуются гравитационные ступени и гравитационные площади. Описывается их пространственное распределение и приводится схема размещения горизонтальных градиентов силы тяжести на территории Латвии. Выявляются закономерности размещения градиентов в разных частях Латвии: Западной, Центральной и Восточной. Рассчитываются средние уровни градиентности гравитационного поля для отдельных аномальных структур и административных районов, на основе которых производится корреляция районов и разрабатывается схема их корреляции по данному параметру.

В заключительном разделе дается эколого- демографичесская оценка территории Латвии по градиентности аномального гравитационного поля, которая изображается также на схеме. По критериям величины градиентов и знака гравитационного поля выделяются три эколого- геофизические группы градиентных территорий: а) территории благоприятные для проживания населения (Gq<1,0 мГал/км- в пределах положительного поля силы тяжести); б) неблагоприятные (Gq <1,0 мГал/км- в пределах отрицательного поля и Gq =1,0 -1,5 мГал/км в пределах отрицательного и положительного поля); в) наиболее неблагоприятные (Gq >1,5 мГал/км- в пределах положительного и отрицательного поля). Административные районы Латвии, по величинам средних значений градиентов, относятся к первой и второй группы территорий. К первой группе (благоприятной) относится большинство районов; к второй (неблагоприятной)- Добельский, Лимбажский, Валмиерский, Рижский, Лиепайский.

Подготовленные материалы и карты могут быть использованы в процессе территориального планирования. Они позволяют учитывать воздействие гравиградиентных зон на население и их влияние на демографические показатели