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БАЯНДАМАЛАРЫ

ДОКЛАДЫ

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THE ROLE GIS IN THE ASSESMENT OF ELECTROMAGNETIC RADIATION ON THE EXAMPLE OF A RESIDENTAL AREA

Abstract. Today, one of the important tasks that is set before environmental monitoring is to continuously obtain the necessary data on the state of the environment through the use of remote sensing techniques. It should be noted that remote sensing (hereinafter – RS) is used in the technogenic environment of mankind, which directly creates unfavorable conditions, increasing the statistics of the origin of various types of carcinogenic risks.

The growing consumption of electric energy leads to the construction and commissioning of new energy facilities, as well as to the construction of high-voltage power lines in the residential environment. An important task in this direction is the establishment of sanitary protection zones, taking into account environmental restrictions, which is aimed at reducing social tension among the population located in the zone of active exposure to the electromagnetic field. Given that low-frequency energy objects, like other man-made objects, are characterized by dynamic characteristics and require constant monitoring of the course of changes in continuous processes, which directly affects the change in the intensity of the electromagnetic field. In turn, the modern information platform allows you to simultaneously conduct environmental surveys to identify carcinogenic risks in the selected area at a specific time by entering the necessary data, which are the main factors in setting the maximum permissible conditions.

The development of digital maps based on Arc GIS application programs has a simulation characteristic and allows you to visually assess the dynamics of environmental changes with different variations.

Key words: environmental monitoring, modern information platforms, inversely weighted distance interpolation method, control point, digital maps of the area.

Introduction. The article [1,2] noted the importance of conducting an environmental survey around high-and ultra-high-voltage power lines, which are potentially dangerous, and low-frequency objects in an anthropogenic environment. The level of change in the intensity of the electric and magnetic fields is continuously dynamic, which requires constant monitoring of the course of perturbed events. Therefore, when conducting environmental monitoring, it is necessary to be guided by methods and means from which it is possible to extract reliable and accurate data on certain technogenic objects, in our case, energy objects that directly affect the ecological system [3, 4]. There are a number of methods of environmental monitoring to obtain reliable results about the state of the environment, which are influenced by the intensity of the distribution of the electric and magnetic fields. One of these methods is the method of mathematical modeling or the method of data visualization through the use of new generation information technologies [2, 4, 5, 6, 7, 8].

The geoinformation system (hereinafter - GIS) is a powerful information platform that allows you to develop digital maps of various topologies, graphically visualize spatial geodata and obtain additional necessary data about the objects under study.

ESRI ARCGIS Pro (Arc View) is one of the modern software products for the application of environmental survey analysis. This product of the ARCGIS product line has the following functionality:

- creating interactive maps and preparing them for printing;
- using ready-made templates when creating maps; - embedding of issued maps in other documents and applications;

- interaction with the map using the tools for moving and zooming, hot links, hyperlinks, and object identification;
- create models and scripts that describe workflows to automate the creation, visualization, and analysis of data;
- read, import, and manage a large number of data formats, including third-party GIS formats, CAD drawings, remote sensing data, metadata, and multimedia;
- implementation of spatial data analysis.

When creating a digital map of an area and defining additional spatial data, the ARCGIS Spatial Analyst module was selected as an additional module. The additional ARCGIS Spatial Analyst module has the following functionality:
- additional tools for working with raster data;
- spatial modeling;
- raster and vector algebra (Map Algebra)

The purpose of this study was the development of digital maps by using geoinformation technology, which in turn made it possible to visually assess the impact of the intensity of the distribution of the electromagnetic field on the living environment. As a result, reliable results were obtained, which clearly showed that the main factor in clarifying the sanitary protection zone is the daily and seasonal distribution of electrical loads, the ambient temperature, which directly affects the increase in the level of electric field strength. In turn, the expansion of the zone leads to an increase in the number of infected foci of electromagnetic radiation. Therefore, continuously obtain the necessary data on the state of the environment to allow an objective assessment of the state of the environment that is generated by low-frequency energy facilities and solves specific issues from the point of view of environmental restrictions in the construction and commissioning of new energy facilities on the example of specific residential areas.

Materials and methods of research. When conducting environmental monitoring on the basis of the ESRI Arc GIS Pro geoinformation system (Arc View), the objects under study were taken high-voltage 220 kV power lines located in the Kazygurt microdistrict and residential buildings located in the electromagnetic radiation zone. This area is densely populated, on average, about 50 000 thousand people live in this area. The neighborhood also has schools, kindergartens, and other administrative buildings that increase the pockets of carcinogenic risk generated by low-frequency energy facilities [2,3,5,8,9,10].

Statistics that describe the effects of the characteristic distribution zones of the electric and magnetic fields on the environment are constructed using the buffer of the distribution of the electric and magnetic fields.

To construct the buffer, the inverse weighted distance interpolation (IDW) method was used with an interval of 10 m.

The Inverse Distance Weighting (IDW) method is a deterministic algorithm based on the assumption that the values at the nearest points have a stronger influence on the predicted value than the values at the points that are located further away [7].

The interpolation is based on known values from the vicinity of the given point. It is assumed that each point with a known value has a local influence that decreases with distance. Points located closer to the estimated point are assigned a greater weight than those located further away:

$$z(s_0) = \sum_{i=1}^{m} \omega_i z(s_i) = \frac{\sum_{i=1}^{m} z(s_i) d_{0i}^{-p}}{\sum_{j=1}^{m} d_{0j}^{-p}} \quad (1)$$

where: z(s0) is the estimated value of a point in some locations s_0, $z(s_1)$, $z(s_2)$…… $z(s_n)$ is the value of reference points.

The weights are proportional to the inverse distances (between the data point and the interpolated location), raised to the power of p.

The weights are proportional to the inverse distances (between the data point and the interpolated location) raised to the power of p. As a result, as the distance increases, the weight will rapidly decrease.

The degree of weight reduction depends on the p value. If p = 0, there is no decrease with the distance increase, and since all the weights of λ_i are the same, the predicted value will be the average for all the values of the fragment being searched. As the p value increases, the weights of distant points will rapidly decrease. If the p value is too high, only points located in the immediate vicinity will affect the interpolation.

Geostatistical Analyst uses power values greater than or equal to 1. If p = 2, the method is called inverse distance squared weighted interpolation. p = 2 is used as a default value, although there is no theoretical justification to prefer this value. The impact of changing the p value should be investigated by viewing output data and checking cross-statistics. [11-16].

The surface calculated using IDW depends on the choice of degree (p) and the neighborhood search strategy. IDW is a hard interpolator where the minimum and maximum values (see the figure below) on the interpolated surface can only occur at reference points.

Figure 1 shows an example of a profile of inversely weighted distances.

Figure 1 - Example of a profile of inversely weighted distances

When ranking electric and magnetic fields according to their environment impact degree, the maximum permissible levels of electromagnetic field intensity were used.

Results and discussion. As a result, digital maps were constructed, where the intensity of the distribution of the electromagnetic field in the daytime and at night was visually shown, and by selecting local data, a part of the residential area was identified that is located in the zone of active exposure to the electromagnetic field generated by a high-voltage power line. Figure 2 and 3 show digital maps of the area, with the distribution of the electromagnetic field strength in the residential area of the Kazygurt microdistrict.

In the studies, the zones of intensity of the distribution of the electric and magnetic fields at different times of the day were shown and identified, which are shown in figures 2 and 3.

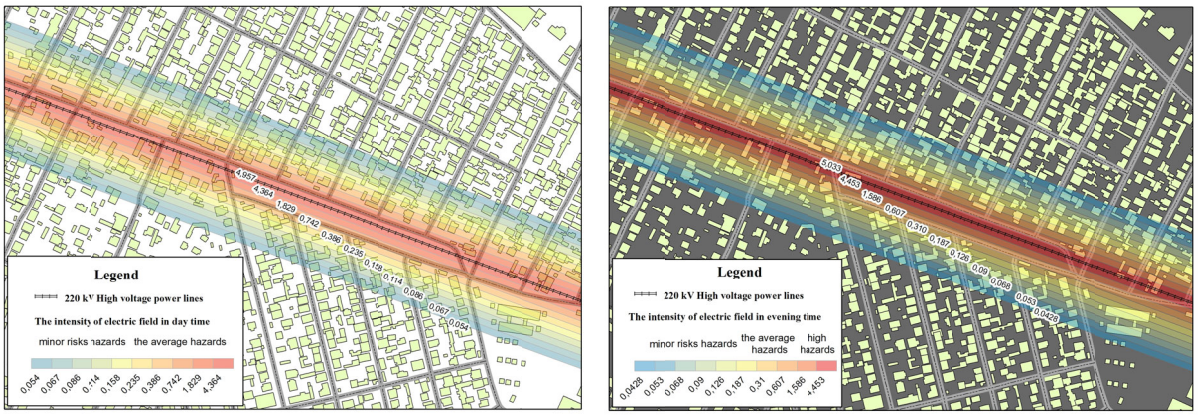

Figure 2 - Digital map of the electric field intensity distribution in the daytime and in the evening

Figure 2 shows that the intensity of the electric field distribution at night has an increased risk, and the area of its impact on the living environment expands accordingly. From the point of view of the sanitary protection zone, the risk zone in the daytime is 30 m, and the risk zone at night is 40 m.

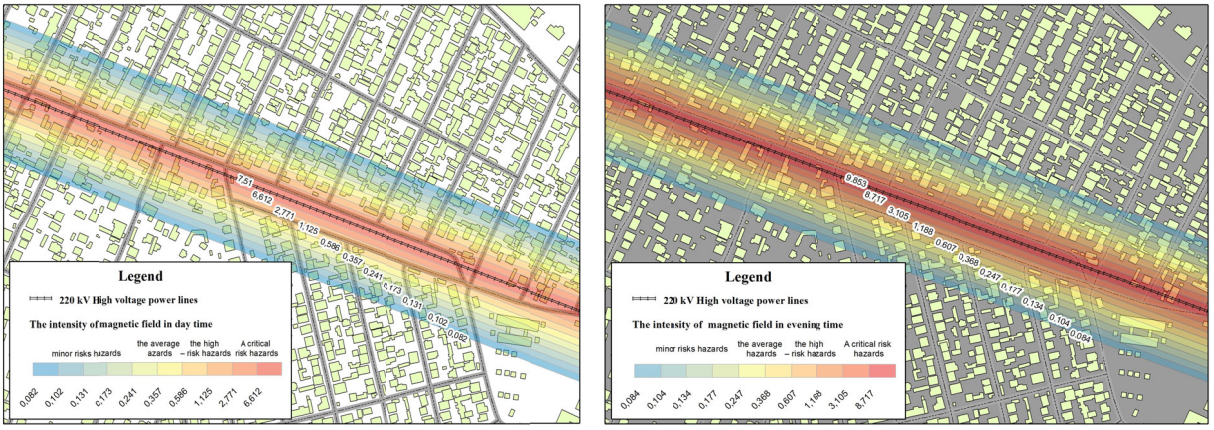

Figure 3 - Digital map of the distribution of the magnetic field intensity in the daytime and in the evening

Figure 3 shows that the intensity of the electric field distribution at night has a critical characteristic from the point of view of environmental risk and, accordingly, the zone of its impact on the living environment expands. From the point of view of the sanitary protection zone, the risk zone in the daytime is 45 m, and the risk zone at night is 60 m.

Figure 4 shows a sample of geolocal data based on the ESRI ArcGIS program. As a necessary parameter, the distance ranges from the initial wire of the power lines to the point of interest were entered. This range was taken by the hazard gradient of the electric and magnetic fields.

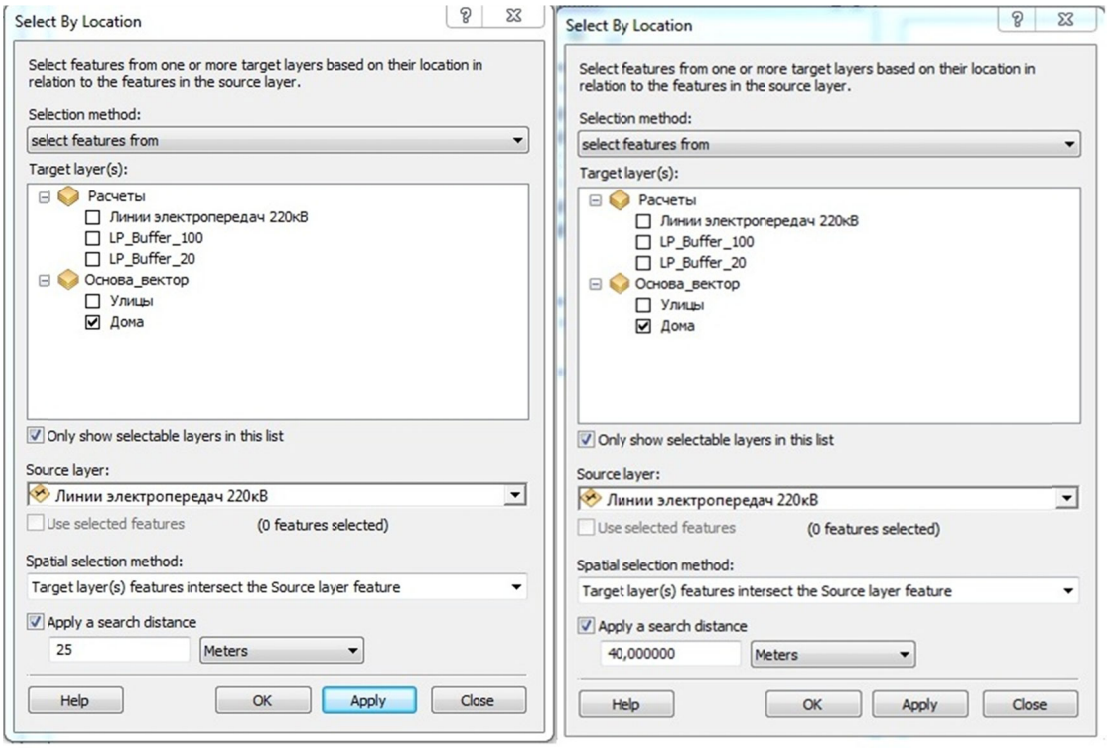

Figure 4 - Selection of geolocal data based on the ESRI ArcGIS geoinformation program

Statistics on residential areas that are located in the zone of influence of the electromagnetic field with a radius of coverage of 25 and 40 m are shown in figure 5.

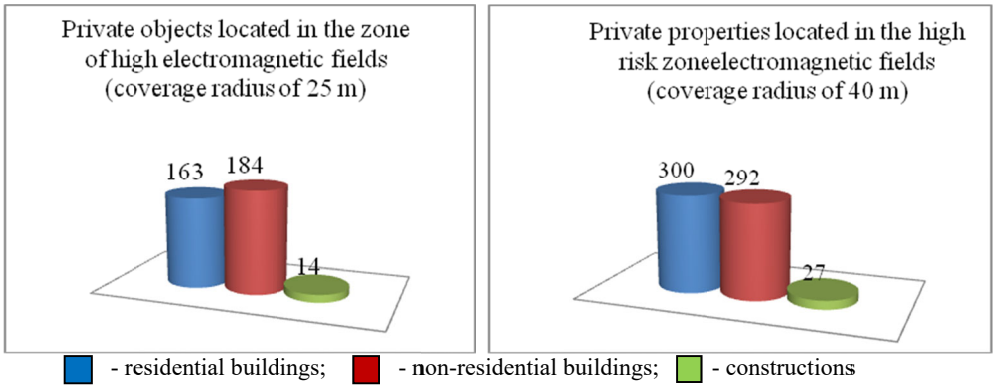

Figure 5 - Diagram of statistical data for residential areas located in the area of increased exposure to the electromagnetic field

Conclusion. The use of geoinformation technologies made it possible to build a digital map of the area. In our case, the input data should be the value of the intensity of the distribution of the electromagnetic field, the degree of its impact on the environment. The output data was obtained by constructing an interpolation of the inversely weighted distance. According to statistical data, as well as according to the literature review and the regulations of sanitary and epidemiological requirements, the radius of coverage of the spread of electromagnetic pollution in the environment of the residential area was 25 m and 40 m.

By introducing local data, as well as by introducing a ranking according to the level of electromagnetic field impact on the environment, the zones of residential areas that are under increased exposure to the electromagnetic field were identified.

The data obtained show that the level of exposure to the electromagnetic field on the environment is transient, which indicates a decrease or increase in the number of residential buildings exposed to the emergence of a carcinogenic risk in the ecosystem

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ТҰРҒЫН ҮЙ АЛАБЫ МЫСАЛЫНДА ЭЛЕКТРОМАГНИТТІК СӘУЕЛЕЛЕНУ ДЕҢГЕЙІН БАҒАЛАУДАҒЫ ГАЖ РӨЛІ

Аннотация. Қазіргі таңда экологиялық мониторинг жүргізу кезінде негізгі талаптардың бірі қашықтықтан зондтау әдісін қолдану арқылы қоршаған орта туралы мәліметтерді үздіксіз алу болып табылады. Өз кезегінде, қашықтықтан зондтау (мұнан әрі – ҚЗ) адамзаттың техногендік мекендеу ортасында қолданыла-тынын атап өткен жөн, ол әр түрлі канцерогендік тәуекелдердің пайда болу статистикасын арттыра отырып, қолайсыз жағдайларды тікелей жасайды.

Электр энергиясына деген сұраныстың артуы жаңа энергетикалық нысандардың салынуына және пайдалануға берілуіне, сондай-ақ тұрғын үй алаптары маңында жоғарғы кернеуліктің электр желілерінің жүргізілуіне алып келді. Бұл бағыттағы маңызды мәселелердің бірі – активті электромагниттік сәулелену ортасында өмір сүретін халықтың әлеуметтік наразылықтарын азайту мақсатында, экологиялық шектеулерді ескере отырып санитарлық-қорғаныс аймақтарын орнату болып табылады. Төменгі жиіліктегі энергетикалық нысандардың, басқа да техногенді нысандар сияқты динамикалық сипаттамаға ие екенін ескеретін болсақ, электромагниттік сәулеленудің өзгеруіне тікелей әкелетін үздіксіз үрдістерді тұрақты түрде бақылау қажеттілігі туындайды.

Өз кезегінде заманауи ақпараттық платформа шектік шарттардың негізгі факторлары болып саналатын қажетті мәліметтерді белгілі бір уақыт аралығында, нақты таңдалынған аймақта канцерогендік тәуекелдерді анықтауға мүмкіндік тудыратын эколдогиялық талдауларды жүргізуге өз септігін тигізеді.

ArcGIS қолданбалы бағдарламасы аясында сандық карталарды өңдеу иммитациялық сипаттамаға ие және қоршаған ортаның өзгеру динамикасын әртүрлі вариацияда визуализациялауға бағалауға мүмкіндік береді.

Түйін сөздер: қашықтықтан бақылау, геоақпараттық технологиялар, кері өлшенген қашықтықты интерполяция әдісі, тірек нүктелері, сандық карталар.

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РОЛЬ ГИС ПРИ ОЦЕНКЕ УРОВНЯ ЭЛЕКТРОМАГНИТНОЙ РАДИАЦИИ НА ПРИМЕРЕ ЖИЛОЙ ЗОНЫ

Аннотация. На сегодня одной из важных задач, которая ставится перед экологическим мониторингом, является непрерывное получение необходимых данных о состоянии окружающей среды путем применения методики дистанционного зондирования. Следует отметить, что дистанционное зондирование (далее – ДЗ) применяется в техногенной среде обитания человечества, которая напрямую создает неблагоприятные условия, повышая статистику зарождения различного вида канцерогенных рисков.

Рост потребления электрической энергии приводит к строительству и введению в эксплуатацию новых энергетических объектов, а также к проведению линии электропередач высокого напряжения в жилой среде. Важной задачей в этом направлении является установление санитарно-защитных зон с учетом экологических ограничений, которая направлена на снижение социальной напряженности среди населения, находящегося в зоне активного воздействия электромагнитного поля. Учитывая, что низкочастотные энергетические объекты, как и другие техногенные объекты, отличаются динамической характеристикой и требуют постоянного отслеживания за ходом изменения непрерывных процессов, которые напрямую воздействуют на изменение напряженности электромагнитного поля. В свою очередь, современная информационная плат-форма позволяет параллельно проводить экологические обследования по выявлению канцерогенных рисков на выбранной территории в конкретный момент времени путем введения необходимых данных, являющихся главными факторами при установлении предельно допустимых условий.

Разработка цифровых карт на базе прикладных программ Arc GIS имеет имитационную характеристику и позволяет визуально оценивать динамику изменения окружающей среды при разных его вариациях.

Ключевые слова: дистанционный мониторинг, геоинформационные технологии, метод интерполяции обратно взвешенного расстояния, опорные точки, цифровые карты.

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